JOURNAL
of
FARM ECONOMICS

Joint Annual Meeting of AFEA and WFEA
Fort Collins, Colorado, August 13-16 1961

Eleventh International Conference of Agricultural Economists
Cuernavaca, Mexico, August 19-30, 1961

Proceedings Papers, Joint Meetings of the American Farm Economic Association and Allied Social Science Associations

Contents continued on Cover II

THE AMERICAN FARM ECONOMIC ASSOCIATION

Volume XLIII MAY, 1961 Number 2

Price: $9 per year, this issue $2.00

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P.L.&R., authorized November 27, 1931. Printed in U.S.A.

THE JOURNAL OF FARM ECONOMICS is published five times a year during February, May, August, November and December by The American Farm Economic Association. Yearly subscriptions $9. Published at Menasha, Wisconsin.

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JOURNAL OF FARM ECONOMICS

Volume XLIII MAY, 1961 Number 2

ACCEPTANCE AND YIELD OF CHOICE AND GOOD BEEF: RESEARCH RESULTS AND IMPLICATIONS*

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Introduction

THIS paper reports the results of a major consumer acceptance experiment with Choice and Good beef. But it is much more than a research report. The more difficult task of relating these research results to present marketing concepts, practices and institutions is attempted via three steps as follows:

(1) The review of recent research on the comparative retail yield of Choice and Good beef.

(2) The discussion of factors besides acceptance and yield which currently affect the relative market value of Choice and Good.

(3) The systematic development of implications of acceptance and yield research. To facilitate such inference, a number of propositions and ideas about the present market situation are set forth. A threefold classification of consumer preferences is conceptualized. The research implications are related to this set of propositions and concepts.

Those readers who are knowledgeable in this area will immediately recognize the scope of the task and will understand the omission of much detail. Although the paper's purpose is broad, it still must omit many subsidiary issues related to the methodology of consumer research, the total set of factors affecting beef quality and consumer acceptance, many of the economic and technical aspects of grading, the various aspects of packer and retailer competition, etc.

The restriction of the research and the discussion to Choice and Good beef is not without cause. Choice and Good beef enjoy not only the pre-

* Contribution from the Missouri Agricultural Experiment Station. Approved by the Director, Journal Series No. 2280. Experiments reported here are parts of a comprehensive research effort conducted by H. D. Naumann, Elmer R. Kiehl, Margaret Mangel, and the author. The helpful criticisms of Darrell Fienup are gratefully acknowledged.

ponderance of the retail demand[1] but also nearly monopolize the controversies related to grading. Questions concerning the acceptability of Cutter, Canner, Utility and (sometimes) Commercial beef are answered by the meat grinder. Questions concerning the acceptability of the high-prestige and high-priced Prime could be thought unproductive and even impolite. Standard grade is a legitimate contender for acceptance research except that its minor volume makes it of somewhat marginal interest.

Researchers have already established the general similarity in acceptance of Good and Choice beef.[2] However, specific problems of importance remain. The meat trade is quite often interested in segments within a grade; some retailers reportedly concentrate their purchases in only ⅓ or ½ of a grade. A current grading controversy concerns the lowering of the Choice-Good boundary a fraction of a grade. To meet this clear need for a detailed and definitive study of the consumer acceptance of segments of the Choice and Good grades, a large research experiment by thirds of grades was conducted. A concurrent relating of acceptance to marbling was also deemed appropriate because of the heavy dependence of grading standards upon marbling as an indicator of quality.

The Consumer Acceptance of Choice and Good

Experimental procedure. As a test of comparative acceptability of beef in the Choice and Good grades, a total of 560 short loins were eaten and evaluated by a panel of 400 consumers.[3] The panel consisted of adults in 200 families selected from a heavily urbanized section of St. Louis County, Missouri. Income levels ranged from low-middle to very high.

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[1] *Livestock and Meat Situation,* March, 1958.

[2] V. James Rhodes, Elmer R. Kiehl, D. E. Brady and H. D. Naumann, *Predicting Consumer Acceptance of Beef Loin Steaks,* Mo. Res. Bul. 651.

V. James Rhodes, Max F. Jordan, H. D. Naumann, Elmer R. Kiehl and Margaret Mangel, *The Effect of Continued Testing Upon Consumer Evaluation of Beef Loin Steaks,* Mo. Res. Bul. 676, 1958.

V. James Rhodes, H. D. Naumann, Elmer R. Kiehl, D. E. Brady, and Ruth Cook, *A New Approach to Measuring Consumer Acceptability of Beef,* Mo. Res. Bul. 677, 1958.

Robert Graf, "Beef Studies," *Reciprocal Meat Conference Proceedings,* 9:64-67, 1956.

D. H. Kropf and R. L. Graf, "The Effect of Grade, Weight and Class of Beef Carcasses upon Certain Chemical and Sensory Evaluations of Beef Quality," *Food Technology,* 13:719-21, Dec. 1959.

George W. Campbell, *Consumer Acceptance of Beef: A Controlled Retail Store Experiment, Phoenix, Arizona,* Ariz. Ag. Expt. Sta. Rept. 145, 1956.

Marilyn Dunsing, "Visual and Eating Preferences of Consumer Household Panel for Beef of Different Grades," *Food Research,* 24:434-44, 1959.

J. W. Cole, D. D. Brannan, and C. S. Hobbs, "Consumer Preferences and Organoleptic Studies as Related to Federal Beef Grades and Selected Beef Carcass Characteristics," *J. Animal Science* (abstract), 16:1074.

[3] Both procedure and results, including the small variation of ratings by season of slaughter, are explained much more fully in a forthcoming Missouri Research Bulletin.

A two stage probability sample was drawn. A sample of 20 tracts was drawn from the 42 census tracts in the area after the probability of drawing a tract had been weighted by its estimated population. From randomly selected starting points within these 20 tracts or "neighborhoods" serial samples of 10 cooperating households were drawn.

Short loins were obtained from 560 carcasses weighing 600 to 650 pounds and identified by third of grade by regular federal graders in the packing plants. After being aged 10 to 11 days at 36 to 38°F., the loins

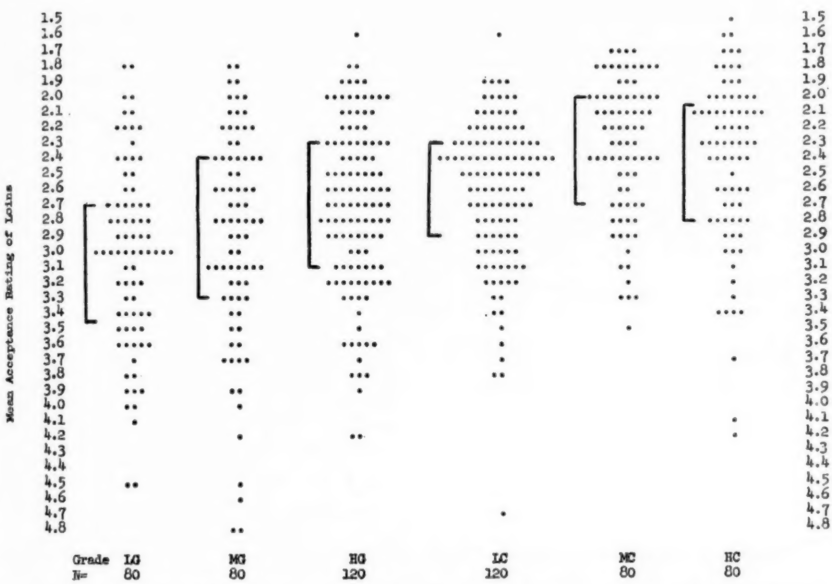

FIG. 1. ACCEPTANCE MEANS OF 560 BEEF LOINS (BRACKETS INDICATE THE TWO MIDDLE QUARTILES OF EACH DISTRIBUTION).

were frozen. Ten steaks of uniform trim and thickness (¾ inch) were cut from each loin.

Each of the two cooperating adults in each household received and evaluated a steak each test week for a total of 14 test weeks spread over the year in four test periods of 4, 3, 4 and 3 consecutive weeks each. Households were asked to use consistently their preferred cooking method. Each steak was evaluated on a nine-point hedonic scale. The two steaks received by a household were always from the same position on the loin. During any given test week, the two steaks received by a household were from adjacent thirds of grades. Each person received nearly the full range of grades during each test period. For example, each of 200 persons ate High Choice, Low Choice and Middle Good loins during each and every test period. At the same times, their 200 spouses ate Middle Choice, High

Good and Low Good loins. No mention was made of grade or quality, but spouses were told that their steaks were never from the same loin. Panel cooperation was excellent during the 12 month period. More than 90 per cent of the original panel completed the year-long project.

To maximize the socio-economic diversity of cooperators testing each loin, its ten steaks went to ten different neighborhoods, where they were eaten by five men and five women.

Acceptance by grade. The mean ratings of the 560 loins, identified by thirds of grade, are compared in Figure 1. The higher the loin acceptance mean is on the vertical scale, the better was its average acceptance as rated by ten consumers. The basically weak relationship of grade to consumer acceptance is no surprise, since it has been established already by a series of studies.[4] The contribution of this large study is the detailed specification of the relationship by thirds of a grade.

TABLE 1. CONSUMER ACCEPTABILITY OF LOINS BY THIRD OF GRADE

Grade	Median	Mean	Upper and Lower Boundaries of Two Middle Quartiles	Percentage of Loins Rating Poorer than		
				4.0	3.75	3.50
H. Choice	2.3	2.43	2.0–2.8	2.5	3.8	3.8
M. Choice	2.25	2.33	2.0–2.7	0.0	0.0	0.0
L. Choice	2.5	2.62	2.3–2.9	0.8	2.5	4.2
H. Good	2.7	2.72	2.3–3.1	1.7	5.0	10.0
M. Good	2.8	2.92	2.4–3.3	6.0	10.0	17.5
L. Good	3.0	3.02	2.7–3.4	3.8	12.5	20.0

The data can be summarized and compared in many ways. A few measures are indicated in Table 1. I would emphasize these points:

(1) The high acceptance of most loins.

(2) The small minority of loins of inferior acceptance.

(3) The general presence of highly acceptable loins in all grade segments.

4) The presence of inferior acceptance loins mainly in Low and Middle Good.

It is my judgment—based on the consumer comments, the ratings and related data in this and several previous experiments—that the dividing zone between acceptable and inferior loins is 3.5 to 4.0. By the stricter boundary of the 3.5 rating, 91.1 percent of the loins were acceptable to consumers; lower the boundary to include 4.0 ratings and 97.7 percent were acceptable. Whether 3.5, 3.75 or 4.0 is used as the acceptability boundary there was a relationship of the proportion of inferior loins to grade. For example, 3.8 percent of the 80 High Choice loins had mean

[4] Cf. footnote 2.

ratings poorer than 3.75 as contrasted with 12.5 percent of the Low Good grade.

In summary this test has provided substantial experimental evidence that Choice and Good do not differ much in acceptability, that the upper third of the Good grade is quite acceptable while the lower two-thirds of the Good grade may be acceptable in some retail situations.

It may be objected that there are other cuts besides short loins. Admittedly, but the research deficiency is more apparent than real. The market does not now distinguish considerably in price between any Choice and Good wholesale cuts except the loin and the rib. The other cuts mainly undergo moist heat cooking in which any small initial differences in acceptance tend to be reduced even further. If there are palatability differences to be found by grade, they should be in the loin.

Acceptance by marbling. Photographs were made of the marbling of 380 of these loins. The linear correlation coefficient between degree of marbling and consumer acceptance was only 0.21. This coefficient compares closely with one of 0.26 found by Wellington and Stouffer,[5] but it is smaller than the 0.56 found by Doty.[6] These two studies used ratings of laboratory panels rather than consumers, and much smaller numbers of loins. It should now be clear that the popular use of "quality" in grading standards as synonymous with "eating quality" is not justified.

Similarity of preferences. The degree of similarity of consumers' preferences has important marketing implications, which are commented on later in this paper. The variation in palatability of loins and the small number of persons who test any given loin limit severely the generalizations which can be made about the variation in preferences of consumers. It can be clearly shown, however, that there were no consumer groups consistently preferring any grade or grade segment. Each consumer rated the same three segments of grades in the four test periods. For example, High Choice, Low Choice, and Middle Good were rated by each of 200 consumers. Very few consumers rated the same third of grade highest[7] in as many as three of the four test periods. There was no evidence of a group of "discriminating consumers" who always detected High Choice and rated it best, despite the high esteem with which such a group is held in the mythology of beef grading and merchandising. The evidence does indicate that consumers often differed considerably as to ratings of a given loin and even as to general level of ratings.[8] Some consumers were apparently more tolerant (or less conscious) of an acceptability deficiency

[5] G. H. Wellington and J. R. Stouffer, *Beef Marbling—Its Estimation and Influence on Tenderness and Juiciness,* Cornell Ag. Exp. Sta. Bul. 941, 1959.

[6] D. M. Doty, "Laboratory Characteristics of Graded Beef Carcasses," *Recip. Meat Conf. Proc.,* 9:10-18, 1956.

[7] Without a tie rating with one or both other grades.

[8] See forthcoming Research Bulletin for a detailed analysis of variance.

than others. Nevertheless, there was no evidence of opposing groupings of consumers who preferred greatly different attributes in beef steaks.

Trimmed Retail Yield of Choice and Good

While many retailers run "cutting tests" to guide their purchasing and merchandising, across-the-board "yield" results have not been generally available. Moreover, yield is greatly affected by the degree of trimming and, thus, may vary with differing retail practice over time and from store to store.

Woodward, *et. al.*, reported that thickness of fat was better related to carcass grade (r = .43) than was area of eye muscle (r = .08). They suggested that "since the ultimate value of the carcass is enhanced more by a large eye muscle than by excess external fat, it is possible that thickness of external fat received too strong a consideration in the grading."[9] While finish appears to have been recently de-emphasized in grading practice, the so-called "higher" grades do generally carry more external fat.

Butler reported in 1957 that fatness of carcass was the main determinant of the percentage yield of wholesale cuts and that the two variables were inversely related.[10]

Published fragmentary results of USDA research initiated some seven years ago indicate that trimmed retail yield is primarily an inverse function of finish and, secondarily, a function of conformation. Average differences in retail value of $4 to $5 per cwt. are reported between high and low yielding groups within a grade, while extreme differences between carcasses approach twice the average figures.[11] While yield differences, between grades have not been released, the functional relationship of yield and finish indicates that Good grade carcasses will have, on the average, better retail yields of trimmed popular cuts than Choice—perhaps as much as 3 percent better.

The cutting test results of Quartermaster researchers on 160 carcasses are indicated in Table 2.[12] All cuts were boned and trimmed to ½ inch ex-

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[9] R. H. Woodward, et. al., *Relationship Between Pre-slaughter and Post-slaughter Evaluation of Beef Cattle,* USDA Circ. 945, 1954, cited in O. D. Butler, "Type and Quality in Live Animal and in the Carcass," Paper at Natl. Beef Industry Conf., Purdue, 1959. Data based on measurements of 635 steer carcasses.

[10] O. D. Butler, *Op. cit.* Data based on six years of cut-out tests. A useful review of related yield research is contained in this paper.

[11] David Pettus, "New Developments in Livestock Marketing Services," USDA mimeo, Dec. 5, 1958; J. C. Pierce, *et. al.,* "Some Factors Influencing Yields of Wholesale and Retail Cuts from Beef Carcasses," paper given at Amer. Soc. An. Prod., 1956; E. J. Warwick, "Effects of Breeding on Beef Carcass Characteristics," *Proc. Reciprocal Meat Conference,* 1958.

[12] "Estimation of Boneless Beef Yield from Carcass Beef," Interim Report by Donald Kropf, QMF&CI report No. 3-58, Feb. 1958. Very slightly revised percentages are published in a more recent paper without cost figures, but the differences in per-

ternal fat, and ground beef contained 25 percent analytical fat. Cost figures reflect market conditions in February of 1958 at a time of a relatively narrow spread (about $2.25) between Choice and Good prices.

These figures on boneless beef are not completely comparable with USDA yield figures of bone-in and boneless popular retail cuts, but they show the same tendency for the leaner carcasses to yield more usable meat.

We can conclude that evidence is being accumulated to show that trimmed retail yield is a very important potential value determinant for beef. While yield has some effect now as a value determinant, its relative importance is certain[13] to increase as (1) yield data become more widely disseminated and understood among buyers and sellers and (2) as the realization grows of the nearly homogeneous consumer acceptance of Choice and the upper third of Good.

TABLE 2. YIELD AND COST OF BONELESS BEEF FROM VARIOUS SOURCES

Class, Weight	Grade	Percent Boneless Beef	Carcass Cost per cwt.	Cost per 100 lbs. boneless beef
6–7 cwt. Steers	Choice	64.51	$43.00	$66.85
	Good	66.09	39.00	58.89
8–9 cwt. Steers	Choice	61.30	40.00	65.20
	Good	64.96	38.00	58.52
4–5 cwt. Heifers	Choice	65.46	42.00	64.26
	Good	66.62	38.00	57.00
6–7 cwt. Heifers	Choice	58.70	42.00	71.40
	Good	61.90	37.50	60.75

Other Value Determinants

Appearance, "bloom," shelf-life, trim loss during aging, and other handling and merchandising characteristics influence the relative value of various beef carcasses to a retailer. Beef as lean as Standard is considered to be somewhat deficient in shelf-life and in ability to withstand aging. However, there is little difference between Good and Choice in these respects according to unpublished research at the Missouri Meats Laboratory. Shaw of Safeway Stores, after pointing out the handling problem of

centages by grades are as large or slightly larger than reported here. Detailed percentages by cuts are also given. D. H. Kropf and R. L. Graf, "The Effect of Carcass Grade, Weight and Classification Upon Boneless Beef Yield," *J. Animal Science,* 18: 95-103, Feb. 1959.

[13] Such "certainty" is contingent upon a continued wide divergence in value between retail cuts and trimmed beef tallow, which seems very likely, even though new uses such as for jet plane lubrication may boost the tallow market a bit.

leaner grades, commented that they could adapt their operations to leaner beef than Choice if they felt it warranted by consumer demand.[14]

Institutional commitments to a grade name may also be a value determinant at present. While this institutional hypothesis may disturb our neat sense of straight-forward transmission of consumer preferences by retailers, certain evidence supports the hypothesis. Williams has reported that about four times as much low Choice as high Good was rolled by federal graders in certain plants of national packers.[15] Does this ratio reflect retailer's beliefs in the relative advertising appeal of the "Choice" and "Good" names? Pilot research with consumers in one small Missouri city suggests that the word "Choice" does denote much better quality to a majority of consumers than "Good," even though they know little about the actual technique or components of beef grades.[16] Williams concludes that "access to the merchandising 'magic' of the word 'Choice' appears to be the single most important factor explaining increases since 1950 in the voluntary use by chains of Federal grades on beef."[17]

A leading retailer indicated clearly the commitment of his organization to grade names. In a recent address, he sharply criticizes the Choice grade as excessively fat. Is he shifting to Good? Not at all. He suggests a rewrite of the grade standards "which will give Mrs. Consumer the type of beef she wants, that is the top grades stamped U.S. Prime and U.S. Choice"[18] In other words, take the high yielding beef with the finish typical of Good and give it the top grade names. This attitude is foreign to much of the textbook material about the functions of grades. However, a careful appraisal of the meat industry and of consumer attitudes suggests that the retailer has grown to be by far the most important market force in determining the use of grade labeling. Then retailers may have some special rights in determining the nature, content, and even the names of grades. To pursue this suggestion further would lead into an area which is larger, more complicated, and more controversial than this one.[19]

Implications

These research results change the market information available to market participants. The research implications are, therefore, inferences con-

[14] Seth Shaw, "Means of Strengthening Consumer Preference Studies," *Proc. Recip. Meat Conf.*, 1957, pp. 99-102.

[15] Willard Williams, Earl Bowen and Frank Genovese, *Economic Effects of U.S. Grades for Beef*, USDA Marketing Res. Rept. No. 298, pp. 44-45.

[16] Unpublished research by the author.

[17] Williams, Bowen and Genovese, *Op. cit.*, p. 140.

[18] N. L. Chaplicki of National Tea Co., "Consumers Don't Want Over-Fat Beef and Retailers Don't Like it Either," *National Provisioner*, March 5, 1960.

[19] For a short history of the forces which developed beef grade marking see V. James Rhodes, "How the Marking of Beef Grades Was Obtained," *J. Farm Econ.*, Feb. 1960, pp. 133-49.

cerning the impacts of the change in market information. Inferences must be drawn cautiously because of uncertainty as to the exact nature of present market information, the speed and effectiveness with which this new information is distributed through the market, and the changes in grading and merchandising which may or may not occur.

These research implications are discussed in four sections as follows:
(1) Impact on producer and consumer decisions and welfare.
(2) Relation to recent proposals to alter grading standards.
(3) Theoretical implications of the similarity of consumers' preferences.
(4) Relation to the competition between Choice and Good.

Producers and consumers

Producer and consumer equity. It has been suggested that "grading serves the end of equity for the individual producer and for the individual consumer as well."[20] "If a man produces a better beef, he should be rewarded for it."[21] While these research results show that present grade sorting into Choice and Good leads to a more equitable association of "worth" and price than no sorting at all, they also clearly show that much is to be desired. For example, a high-yielding, high acceptance Good carcass is "worth" considerably more to a retailer and to his customers than a poor-yielding, low acceptance Choice carcass, but the latter tends to get the price premium. The producer of the former suffers a considerable price discount because of the occasional Good loin of inferior acceptance. The accurate recognition of yield differentials by "dual grading" or a similar private system would go far to reduce these inequities. The development of more accurate means of sorting carcasses as to consumer acceptance would also lead to an important reduction in present inequities.

Returns to producers and expenditures by consumers. What will be the effect on the sales receipts of Choice and Good beef of the effective dissemination of better consumer information about their relative acceptability? It would seem apparent that more information means a better satisfaction of wants and probably more sales revenue. A preference researcher has vested interests in resting the argument at this point. Unfortunately, the conclusion may be wrong. As many a salesman has discovered, sales revenue may be greater when consumer information is "incorrect" than when it is "correct." To state it another way, the supplying of an "altered" set of wants may yield more total revenue than the supplying of an "unaltered" set. The "product images" of Choice and Good and the consumer demands for them have been determined by past satisfaction, education, promotion and myth, among other things. Therefore, it appears impossible

[20] Harold F. Breimyer, "The Purpose of Grading," paper at Natl. Beef Grading Conf., Kansas City, Nov. 14-15, 1960, pp. 4-5.
[21] *Ibid.*

to predict the net effect of better consumer information on the total sales receipts, even though the direction of the effects on the sales receipts of each grade can probably be predicted.

Production decisions. Present production decisions are rationally guided by present and anticipated market prices and present market quality information. Breeders and producers will be concerned about this new market information as it may affect future product specifications and prices. External fatness above, say, 0.5 inch over the ribeye may be penalized much more in the future than now. Marbling may diminish in importance as a value determinant. These research results indicate that the rather minor palatability enhancement associated with ample marbling probably does not justify much sacrifice of lean yield or ability to gain or other important breeding characteristics. On the positive side, these research results encourage further experimentation in breeding, feeding and processing with the objective of producing both high yield and high acceptability.[22]

Recent proposals to modify grade standards

Changing the Choice-Good grade boundary. These research results have implications for the recent suggestion that the Choice-Good boundary be lowered to include the upper part of the Good grade.[23] The hypothesis behind the proposal is that moving the grade boundary down would likewise lower the qualities demanded by mass retail buyers.[24] There is no convincing evidence as to the truth or falsity of the hypothesis. If the hypothesis is true, then grades are a powerful determinant of demand rather than a passive reflector. If so, then graders bear a heavy responsibility to all market segments in determining where optimal grade boundaries shall be. If the hypothesis is true, then lowering the grade boundary would reduce the absolute production costs of Choice (of the beef formerly graded Good) and would also reduce slightly the average consumer acceptability of Choice. Whether the advantage of the cost reduction would offset the disadvantage of the slight palatability reduction is a matter of speculation.

On the other hand, if the hypothesis is false, the burden of the "liner"

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[22] Hazel Stiebeling, "Beef for Family Use," USDA mimeo., paper given at Natl. Beef Industry Conf., Purdue, 1959; "Beef Tenderness and the Search for a Meat Type Steer," *National Provisioner,* Jan. 31, 1959, pp. 15-16; E. J. Warwick, "Genetic Aspects of Production Efficiency in Beef Cattle," Mimeo., paper at Natl. Beef Industry Conf., Purdue, 1959.

[23] "Statement of Western Beef Producers," Natl. Beef Grading Conf., Kansas City, Nov. 14-15, 1960.

[24] This hypothesis is sometimes stated in terms of a general tendency toward quality deterioration. It is said that the forces of price-quality competition and consumer ignorance would lead to marked deterioration of retail beef quality if it were not for grades.

problem[25] might be largely transferred from federal graders to private parties. If the hypothesis is false, there are market forces, aside from grades, which determine the relative market popularity of various beef qualities. Lowering the Choice-Good boundary would reduce the controversial liner problem. The size of the Choice-Good liner problem is assumed to be in direct proportion to the number of carcasses falling on and near the Choice-Good boundary. The great popularity with retailers of the lower part of Choice grade reportedly has led to a high proportion of beef being fed with the aim of reaching a point just above the Choice boundary. The close proximity of the Choice-Good boundary to this general "target-area" of many feeders leads to many liner carcasses. It then follows that moving the boundary away from this "target-area" would greatly reduce the number of the Choice-Good liners. However, the liner problem might be somewhat transferred from the graders to those checking private specifications. For example, large-scale retail buyers desiring present low Choice beef could no longer depend on the grade to delimit the lower boundary of their beef; instead they would have to set up their own limits.

Whether the transfer of many liner problems from federal graders to private firms is desirable or not appears to lie outside the province of economics. Whether such a transfer would actually occur depends upon whether grade lines do or do not powerfully influence qualities demanded. It is also possible that grade boundaries presently affect qualities demanded within narrow limits and that market forces are controlling beyond those limits.

A downward movement of the Choice-Good boundary without a corresponding movement of the Choice-Prime boundary would reduce slightly the interchangeability (as to acceptance and retail yield) of carcasses within the Choice grade. However, Choice would still meet Engelman's suggested criterion that heterogeneity within a grade should be less than in the total supply.[26]

Dual grading. A second recently suggested change is the proposal to adopt dual grading[27]—i.e. a two-way grading of carcasses as to retail yield and as to quality. The possible equity gains of dual grading have already been discussed. If third-party, federal grading is required to obtain market recognition of value differences arising from yield differences, then it

[25] The division of a continuous distribution into two or more discrete groups naturally requires a number of difficult and controversial decisions about those units falling on the boundary lines between the groups.

[26] Gerald Engelman, "An Economist looks at Meat Grading and Consumer Studies," *Proceedings of the Conference on Consumer Studies*, Univ. of Mo., Sept. 1957. Cf. also V. James Rhodes and Elmer R. Kiehl, "On Consumer Grades for Foods," *J. Farm Econ.*, Feb. 1956.

[27] C. G. Scruggs, "Tale of Two Steers," *The Progressive Farmer*, Nov. 1960.

has important economic incentives. Ultimate reduction in tallow wastes will represent a sizeable reduction in marketing costs from which both consumers and farmers should benefit. Admittedly, however, many producers and marketing firms will likely withhold their approval of dual grades until the potential impacts upon their individual operations are more clearly understood.[28] Information is presently very inadequate concerning the distribution of yield grades of present cattle production as they relate to breed, feeding practices, weight, present grades, etc. Nor can the impact of a shift to dual grading be anticipated without more accurate knowledge of the extent to which the meat trade presently recognizes value differences associated with yield.

Theoretical implications of the similarity of preferences

The similarity of consumers' preferences plus the palatability and yield relationships of Choice and Good provide a basis for important inferences concerning:

(1) The future price and volume relationship of Choice and Good;

(2) The appropriateness of the present grade names—Choice and Good.

However, it is first necessary to specify a new set of concepts concerning the comparability of consumers' preferences.

Similarity of preferences. These acceptance results suggest that the St. Louis consumers had "similar" preferences rather than "identical" or "opposing" preferences. I find it helpful to use such classifications rather than the all-inclusive term "different." I define them as follows:

(1) Identical—consumers agree as to quality variations and as to relative prices they are willing to pay for these qualities.

(2) Similar—consumers agree as to quality variations but they do not agree as to relative prices. For example, all consumers agree that this steak is better than that one; one group of consumers would pay as much as 50 cents a pound more to get the better one, while the other group would not pay more than 10 cents a pound to obtain it.

(3) Opposing—consumers disagree as to relative qualities and prices. For example, one group of consumers thinks this steak is better than that one, while another group thinks the converse.

Differentials in consumer incomes and similarities in eating tastes of consumers are probably the bases for similar preferences. Income differentials alone are likely to be sufficient to yield similar rather than identical preferences for steaks. However, there are indications from the data that some consumers react more strongly than others of equal incomes to quality variations, so there may be a lack of identical preferences within the same income group. Income differentials, per se, would

[28] Cf. talk of Lester Bookey of National Independent Meat Packers at Natl. Beef Grading Conf., Kansas City, Nov. 14-15, 1960.

not produce opposing preferences, although the consumption habits long associated with particular income levels might conceivably encourage opposing preferences.

While consumers have different degrees of tolerance for lack of juiciness or flavor or tenderness, there appear to be virtually no consumers who *prefer* a less tender and dry steak to a more tender and juicy one. Although some consumers clearly prefer rare to well-done steaks and other consumers prefer the opposite, there appears to be no similar bipolar distribution of natural flavor in Choice and Good loins between which consumers divide.

While the St. Louis consumers in this panel clearly did not have identical preferences, the proposition that almost all had similar preferences is a more tentative one. When loins with marked palatability differences were rated, the similarity of preferences was quite apparent. However, when loins with very small palatability differences were rated, the relative ratings often did not agree. I regard this minor disagreement over essentially similar products as unimportant; other researchers may disagree and may insist that such results indicate that all preferences are opposing.

Correlation of market quality and price. While the distinction between similar and opposing preferences may be difficult to establish empirically, the conceptual difference is an important one. First, market price and quality tend to be correlated when individual preferences are similar, while any such correlation is pure happenstance[29] when preferences are opposing. The logic of this proposition is as follows. Assume that the economy is sufficiently competitive to assure that the relative prices of various product qualities are normally equivalent to their relative costs (production plus processing). With opposing preferences two different "qualities" of similar cost—and price—may coexist in the same market, because one group of consumers prefers the one quality and the other group prefers the other quality. With similar preferences two different qualities of similar cost—and price—cannot long coexist in the same market because the superior quality would be preferred and purchased by all consumers. It then follows that a correlation of quality and price is a necessary condition for the coexistence of different qualities in the same market when preferencs are similar but is not a necessary condition when preferences are opposing. Sufficiency conditions for such market coexistence when preferences are similar would include conditions relating cost differentials to demand price differentials of various groups of consumers.

Opposing preferences and the advisability of grading. Are grades useful when preferences are opposing? Some economists indicate that grades should have a fairly stable correlation with market value. They

[29] Actually, quality in a single-scale, better-poorer sense is essentially unmeasurable when preferences are "opposing"; a correlation of quality and price becomes arbitrary.

further suggest that product factors on which all buyers agree are those that should go into grades.[30] A National Marketing Workshop group made the following statement. "Standards should separate the products into qualities that will give differences in the degree of acceptability in proportion to the added expense."[31] These statements imply that there should not be grading when preferences are opposing. I do not agree with that implication but I do agree, as suggested above, that the distinction between opposing and similar preferences does have important implications for the nature of grading or sorting. Even when there are opposing preferences, proper use of grades or "sorts" can aid consumers, can aid the transmittal of price information to producers, or can aid promoters in maximizing the total sales receipts of a product.

Competitive relationships of Choice and Good

It appears useful to view Choice and Good as two slightly differentiated—and not very homogeneous—products with fairly high cross-elasticities of demand. These products are "defined" in the market not only by the grading standards but also by the varying levels of market information possessed by market participants as to the characteristics of the products. These products "compete" very vigorously in the sense of the relative ease of substitution on both the supply and demand sides. Whether or not the outcome of this competition affects the welfare of either farmers or consumers as a whole, it does affect the welfare of particular groups of farmers, and possibly of the particular segments of the livestock industry marketing their cattle. Any change in the grading definitions of Choice and Good, or in the marketing information concerning the characteristics of these products, or in demand or supply conditions will affect the competitive relationships.

Choice-Good price differential. If it is granted that consumer preferences are not opposing then the continued survival of both Choice and Good in the market depends upon a maintenance of the proper cost and price differentials. While there are too many indeterminant factors at work to predict price differentials, certain useful speculations can be made. It appears that the important factors to watch will be:

(1) The amount of progress toward proper wholesale price premiums for yield.

(2) Following (1), the amount of progress toward the reduction of wastiness produced in both the Good and Choice grades.

3) The estimation of retailers as to the dollar value to their organiza-

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[30] James R. Bowring, Herman M. Southworth, and Frederick V. Waugh, *Marketing Policies for Agriculture*, Ch. 21.

[31] *Market Demand and Product Quality*, a report of the Natl. Marketing Research Workshop, 1951.

tions of merchandising the U.S. Choice name and the slightly better average acceptance associated with it.

(4) The impact on the Choice-Good average palatability differential of a cheap, effective tenderization method such as recently reported by a major packer.[32]

(5) The amount of progress toward a more accurate sorting as to palatability.

(6) The difference in the costs of producing Choice and Good cattle.

Price results will vary with various combinations of changes in the above factors. It seems apparent that the retail price of Choice can be expected to exceed that of Good in the near future because of the average palatability difference and the merchandising advantages of U.S. Choice. However, the average wholesale price of Good would presently exceed that of Choice if yield were the only criterion. It appears possible that a reorientation of retailer thinking about yield and palatability might lead to very similar wholesale prices for Choice and Good. Even if some wholesale price differential is maintained in favor of Choice, any sizeable reduction in it would presumably affect the relative proportions produced of Choice and Good cattle. If the pricing system discriminates fairly accurately as to yield on an individual carcass basis, it appears possible that the average yield difference between Choice and Good might be reduced over time, and that the production of wasty animals might be severely reduced. All sorts of interactions of relative supplies and prices are possible as changes occur in the delicate balance between quality, yield and cost differentials.

I think it likely that a single grade with high yield and high acceptance will eventually completely dominate the U.S. retail market. On the demand side, the continued growth of incomes of most consumers will reduce the willingness to sacrifice eating quality for a minor price saving. On the supply side, there is the possibility of innovations in production or processing which reduce greatly the extra cost involved in producing a high-quality product and which eliminate the present uncertainty as to what kind of quality has been produced in a given carcass. *Either* development would be sufficient to capture the market for the top quality product.[33]

Similar preferences and grade names. Rank-ordered grade names purporting to establish that one grade is superior to another are probably logical when preferences are similar—because all consumers agree with the ranking—but they are illogical when preferences are opposing. One reservation might be made. If one grade is *slightly* superior to another, but the

[32] *Supermarket News*, May 16, 1960, pp. 1 and 28.

[33] Cf. Breimyer, *op. cit.*, p. 11, for the contrasting view that affluence is conducive to more grades rather than less. I think that Breimyer may be assuming opposing preferences.

grade names indicate that the former is *extremely* superior, then the satisfaction of preferences may be somewhat distorted. This distortion would seem particularly likely if heavy consumer reliance is put on grade distinctions and if the distinction is popularized by private advertising. As mentioned earlier, very limited research suggests that Choice indicates to consumers a much higher level of quality than Good in beef. The results of this acceptance experiment suggest that there should be grade-ranked terms; however, an attempt might be in order via grade descriptions and consumer education to avoid overemphasis of the quality differential between Choice and Good. On the other hand, the reader will note that elimination of ranked grade terms for Choice and Good would be logically required if consumer preferences were opposing. This logical point apparently has not been noted by various commentators who speak of "the crazy-quilt of consumer demand" or who, by other terms, imply opposing preferences for beef.

PROJECTIONS OF WATER REQUIREMENTS IN THE ECONOMICS OF WATER POLICY[1]

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1. *Objectives*

THE meaning of water demand in the professional language of the economist is rarely identical with that of water requirements as used commonly in the extensive literature on water development. My first objective is to clarify the relation between these two concepts and to draw conclusions about the significance of this relation for water policy.

The second objective is to review the logical validity of projecting water requirements into the more distant future—let us say for a decade or more. The intent is not to suggest that one might dispense with long-range economic projections in water policy. Rather, I should like to inquire into possible differences in the logical validity of different kinds of projections. If it can be shown that there are such differences, greater weight in decision making and greater statistical effort should be given to those kinds of projections, the logical validity of which appears greater.

The third objective is to appraise the relevance of projections of water requirements for purposes of water policy. Superiority of a projection in logical validity does not necessarily also mean superiority in usefulness for policy. This objective requires a sketch both of the goals and the tools of water policy. Economists usually refer to the goals as quantitative optima in water allocation and development. As to the tools, one gets the impression from the current rash of optimizing literature that quantitative methods and high-speed computers are the most important ones. Although it may not be popular, I should like to explore whether the study of systems other than the quantitative ones currently in vogue may not be necessary—and sometimes even sufficient—for identifying and implementing goals of water policy.

2. *Water Requirements in Relation to Water Demand*

It is elementary economics that the essence of demand and supply concepts consists of the functional relation—and its changes over time—between prices and physical quantities. In the numerous projections of water

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[1] Giannini Foundation Paper No. 193. Presented before the Western Resources Conference held at the University of Colorado, Boulder, Colorado, August 22-26, 1960. The assignment for this paper was to develop, from the standpoint of water policy, certain ideas broached earlier in: S. V. Ciriacy-Wantrup, "Conceptual Problems in Projecting the Demand for Land and Water," *Modern Land Policy*, ed. Harold G. Halcrow (Urbana: Univ. of Illinois Press, 1960), Chap. 3, p. 449.

requirements, this functional relation is scarcely, if at all, considered.[2] On theoretical grounds, supported by somewhat meager evidence, we may assume that the price elasticity of the demand for water is small within the relevant range for each major water use such as domestic, industrial, agricultural, and recreational. In spite of this small price elasticity, there are several reasons why insufficient consideration of the price/quantity relation leads to an upward bias in projections of water requirements.

In the first place, the elasticity concept is a proportional one. There is little doubt that proportionally the upward changes of water prices that can be expected in most parts of this country and the world will be large. In the past, water has been used without or with only a nominal charge per unit. The economic, institutional, and technological factors responsible for this have recently been investigated.[3] Some of them will be touched upon later. Costs of water development have been covered through various forms of taxes, special assessments, and fees. While a portion of the water bill will continue to be met in this way, there is an upward trend in the portion covered by prices and some economic argument for continuation of this trend. In other words, the expected upward movement of water prices starts at low—sometimes zero—levels. Increases will be large proportionally. With such large proportional changes of prices, even small

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[2] U. S. President's Water Resources Policy Commission, *A Water Policy for the American People* (Washington, 1950), vol. 1.

U. S. President's Materials Policy Commission, *Resources for Freedom* (Washington, 1952), vol. 5, 154p. (Selected Reports to the Commission.)

U. S. Congress, Senate, Select Committee on National Water Resources, *Water Resources Activities in the United States: Land and Water Potentials and Future Requirements for Water,* Comm. Print No. 12, 86th Cong., 1st Sess., S. Res. 48, 1960, 73p.

U. S. Congress, Senate, Select Committee on National Water Resources, *Water Resources Activities in the United States: Estimated Water Requirements for Agricultural Purposes and Their Effects on Water Supplies,* Comm. Print No. 13, 86th Cong., 2d Sess. (i.e., 1st Sess.), S. Res. 48, 1906, 24p.

U. S. Congress, Senate, Select Committee on National Water Resources, *Water Resources Activities in the United States: Future Needs for Reclamation in the Western States,* Comm. Print No. 14, 86th Cong., 2d Sess., S. Res. 48, 1960, 45p.

State of California, Water Resources Board, *Water Utilization and Requirements of California,* State Water Res. Bd. Bull. No. 2 (Sacramento, June 1955), vol. 1, 227p., and vol. 2, 358p.

Edward A. Ackerman, "Water Resource Planning and Development in Agriculture," *J. Soil and Water Conservation,* vol. 14, no. 3, May, 1959, pp. 112-17.

John D. Black, "Resources Needed in American Agriculture," *J. Farm Econ.,* 39: 1074-86, Dec. 1957.

Colin Clark, "Afterthoughts on Paley," *Rev. Econ. and Stat.,* 36:267-73, Aug. 1954.

Edward S. Mason, "Afterthoughts on Paley: A Comment," *Rev. Econ. and Stat.,* 36: 273-78, Aug. 1954.

[3] M. F. Brewer, *Water Pricing and Allocation with Particular Reference to California Irrigation Districts,* Univ. of California, Giannini Foundation Mimeo. Rept. No. 235 (Berkeley, October 1960), 149 p.

elasticities of water demand—let us say around −0.10—lead to considerable absolute changes in quantities.

In the second place, given a sufficient period of time, price elasticity of demand for an aggregate of water uses may be considerable if quantitatively important uses are priced out of the market. For example, rising water prices may force a curtailment of irrigated agriculture in favor of domestic, industrial, or recreational uses. In agriculture, large quantities of water are used with relatively low average value productivities. At this point, I am not interested in the social welfare aspects of such price-induced shifts between major water uses. I am merely suggesting that projections of water requirements already imply policy decisions with respect to water pricing and water allocation among major uses. Since water requirement projections in most studies are to serve as a basis for policy decisions, this point is significant.

If projections are to serve as a basis for water policy, separation of the demand (ends) and the supply (means) aspects of water development becomes conceptually necessary and, in empirical investigations, variables pertaining to demand must be differentiated from those pertaining to supply. Water requirements, on the other hand, are usually identified with water use and are statistically determined by extrapolating past trends in per-capita consumption for domestic and industrial use and in irrigated acreage and water duty per acre for agricultural use. For these trends, changes in supply variables are no less significant than changes in demand variables. For example, the great increase of water use in the 17 western states since 1940 is largely based on ground water development for which changes in pumping technology and relative price decreases of important inputs—such as power—and a favorable water law—if based on the correlative rights doctrine—are responsible. Overdraft on ground water, on the other hand, has led to increased costs of pumping. Furthermore, in many basins, ground water development is identical with ground water mining. Extrapolating water requirements on the basis of past use appears especially hazardous for ground water.

I do not want to leave the impression that separation of demand and supply in water economics is a simple matter, conceptually or empirically. The example just mentioned is an illustration. Water in agriculture is an input and demand for water is derived demand. A meaningful demand function for one input requires reference to prices and quantities of complementary and competing inputs. Power is an input that is used for many purposes besides ground water pumping. Technology in water application is closely related to the technology of applying other inputs, for example, fertilizer. In such cases, changes of prices and quantities of other inputs affect both water supply and water demand at the same time.

The difficulties of separating water supply and demand are especially great if one considers aggregates. This is due to the structure and the functioning of the "water market." Clarification is needed here in view of some current misconceptions.

It is not sufficiently appreciated by most economists that the largest part of aggregate water use is self-supplied by individual water users. Decisions about production and use of water are internal. Such decisions are not expressed through the firm's behavior in a water market. Hence, market-oriented economic concepts have more limited analytical significance for explaining and evaluating the behavior of water-producing and water-consuming firms than is true for other fields of economic inquiry. This holds both for agricultural and nonagricultural uses of water.

According to the 1950 census, 47 per cent of the irrigated acreage in the United States (58 per cent in California) was supplied by single-farm irrigation enterprises.[4] Of the industrial use of water in the United States and in California, 97 per cent was supplied by individual company systems.[5]

The second largest part of aggregate water use was supplied by water users themselves, cooperatively through nonprofit water organizations such as mutual water companies and public districts. In the United States, 28 per cent (in California, 12 per cent) of irrigated acreage was supplied by mutual water companies.[6] The corresponding figure for public districts is 18 per cent (25 per cent in California).[7] Regarding domestic water use, 87 per cent of a population of 79,000,000 in communities of more than

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[4] Developed from data given by the U. S. Bureau of the Census, *U. S. Census of Agriculture: 1950, Irrigation of Agricultural Lands, The United States* (Washington, 1952), vol. III, Table 16, p. 58, and U. S. Bureau of the Census and U. S. Agricultural Research Service, *U. S. Census of Agriculture: 1954, Irrigation in Humid Areas, A Cooperative Report*, Spec. Rept. (Washington, 1956), vol. III, part 6, Table 14, p. 86.

[5] These data are developed from data given in U. S. Bureau of the Census, "Industrial Water Use," *U. S. Census of Manufacturers: 1954*, Bul. MC209 (Supp.) (Washington, 1955), Table 1, pp. 209-2 and 209-3; Table 2, pp. 209-4 and 209-5; Table 6, pp. 209-18 and 209-19; Table 7, pp. 209-20, 209-21, 209-26, and 209-27; Table 8, pp. 209-28 and 209-29; Table 9, pp. 209-30 and 209-31. Water supplied includes fresh, brackish, and mine water but excludes the quantity of water necessary if there were no recirculation. An insignificant proportion of this supply is provided by combination systems and sources not specified. Steam electric plants account for 80 per cent of the industrial water use in California and 67 per cent in the United States. Steam electric plants use 87 per cent of the total brackish water used in industry in California and 77 per cent in the United States. Brackish water in the above tables is not differentiated on the basis of supplying systems. In our computations, brackish water is counted as supplied by company systems. If steam electric plants are excluded from industrial water use, 85 per cent was supplied by company systems in California and 86 per cent in the United States. (See also footnote 19.)

[6] U. S. Bureau of the Census, *U. S. Census of Agriculture: 1950 . . .*, and U. S. Bureau of the Census and U. S. Agricultural Research Service, *U. S. Census of Agriculture: 1954. . . .*

[7] *Ibid.*

25,000, covered by a survey of the U. S. Public Health Service in 1957, was supplied by water systems owned by municipalities or municipal water districts.[8] A comparable figure for California is 89 per cent.[9] All of these water organizations have in common that, in their formation, operation, and growth, water consumers have a direct and significant influence that is outside the demand-supply mechanism of a market. In many respects, the factors affecting decision making in these organizations are similar to those affecting self-supplying firms.

Only a small part of the aggregate water supply is produced for sale by profit-seeking firms. Most of these in turn are regulated by state public utility commissions. In the United States, only 3 per cent of the irrigated acreage is supplied by such firms. In California, the corresponding figure is 4 per cent. Of industrial water use, only 5 per cent is supplied by such firms in the United States and 3 per cent in California. Of municipal water use, the data in the above-mentioned survey indicate that only 13 per cent of the population surveyed is supplied by privately owned systems in the United States and 11 per cent in California.

Seasonal and permanent transfers of water between individual firms and between water organizations occur. In special cases, for example, if water consumers are owners of mutual water companies, seasonal water transfers show market characteristics.[10] Permanent transfer is generally in terms of water rights and is governed by water law. Water exchanges (differentiated by time and location) are not uncommon. They are individual transactions and usually do not involve pecuniary considerations. But they are potentially important for increasing efficiency of water allocation with respect to time, location, and uses. More research is needed on the social performance of these transfer mechanisms. But it is already fairly clear that there is little meaning in speaking of aggregate water demand and supply in the sense of a market in which water-supplying and water-demanding industries meet.

This situation raises a question with respect to the analytical contribution of the term "water industry" that has become popular recently. The problems of water economics, I submit, are more those of the organization and management of self-supplying firms and of governments at all levels than those of an industry as the term is used in economic theory.

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[8] John R. Thoman and Kenneth H. Jenkins, "Inventory of 1956 Water Supply Facilities in Communities of 25,000 and Over," *J. American Water Works Assoc.*, vol. 50, August 1958, Table 3, p. 1078.

[9] Data summarized from U. S. Department of Health, Education and Welfare, Public Health Service, Division of Sanitary Engineering Services, *Municipal Water Facilities Communities of 25,000 Population and Over, Continental United States and Territorial Possessions, as of January 1, 1958*, Public Health Serv. Publ. No. 661 (Washington, 1959), pp. 10-15.

[10] Raymond L. Anderson, "Operation of the Irrigation Water Rental Market in the South Platte Basin," *J. Farm Econ.*, 42:1501-02, Dec. 1960.

Must we conclude, then, that the conceptual and empirical difficulties in dealing with aggregate water demand and supply are so great that we are forced back, after all, to rely on water requirement projections? Before this question can be answered, one must inquire into the validity of economic projections in terms of the logic of inductive inference and into their relevance for water policy.

3. *Validity of Water Requirement Projections*

Projection over time is a special problem of inductive inference. In such projections, all undetermined cases of a hypothesis or of a system of hypotheses—a theory—are future cases. A projection is then called "prediction."

Predictions differ with respect to the degree of articulation in the formulation of hypotheses and with respect to the degree of quantification. On the basis of these differences, "projection" is sometimes differentiated from "forecast" and "estimate." Without endorsing such differentiation, it may be noted here that projections, forecasts, and estimates must be classed as predictions as far as the criteria for their logical validity are concerned. On the other hand, a prediction is not a prophecy. The only criterion that can be applied to a prophecy is the eventual outcome. In contrast, the eventual outcome of an individual case is not, in itself, a sufficient criterion of validity for a prediction. A prediction, in order to be valid, requires tested theories in the sense of "lawlike" generalizations.

Criteria to determine whether a generalization deserves or does not deserve the designation "lawlike" and, therefore, can be used for prediction, have occupied formal logic for a long time. In a small book, little known among economists, Nelson Goodman has suggested a criterion which has attracted some attention in the philosophy of science.[11]

It follows from the Goodman criterion that a high degree of quantification is not a requirement. On the contrary, most lawlike generalizations are phrased on a rather low quantitative level. For example, lawlike generalizations regarding the relations between variables refer to less quantified characteristics—such as general direction of change (increase, decrease), ordinal characteristics of change (greater, smaller, equal, proportional), temporal distribution of change (earlier, later, simultaneous), and tendencies toward correction (equilibrium), or cumulation (disequilibrium)

[11] Nelson Goodman, *Fact, Fiction, and Forecast* (Cambridge: Harvard Univ. Press, 1955), espec. pp. 63-120.

R. Carnap, "On the Application of Inductive Logic," *Philosophy and Phenomenological Research*, 8:133-47, Sept. 1947.

For the classical views, see: John Stewart Mill, *A System of Logic* (London: Longmans, 1843; reprinted, 1947), espec. Book 3, Chap. 3.

The Goodman criterion was discussed at some length in the publication previously mentioned: S. V. Ciriacy-Wantrup, "Conceptual Problems in Projecting. . . ."

-rather than to cardinal characterization of parameters.[12] On the basis of the Goodman criterion, we may conclude that predictive power of a theory and degree of quantification are not correlated positively. Demand theory may serve as an illustration.

If by demand theory one means the broad generalizations in the Marshall-Henderson-Hicks formulation, they will pass Goodman's predictivity test.[13] By the authors themselves and by most economists, these generalizations are referred to as "the" demand laws. Yet their language is couched in terms that refer only to direction of change, that is, increase or decrease of prices and quantities. Elasticities, if mentioned at all, are stated in terms of ordinal characteristics.

On the other hand, there is little possibility of passing the Goodman predictivity test if by demand theory one means a demand function with a quantitative characterization of parameters that would allow demand projections comparable in numerical precision to existing projections of water requirements.

Existing projections of water requirements may be regarded as a species of economic model. Even the best of this particular species is incomplete in the sense that the most significant dynamic variables, namely, changes of technology, preferences, and institutions, are not included or only to a small extent.

Models are not substitutes for theories. Models are designed for better understanding of individual cases—past or future—and may be used for testing theories in the process of validation. Models, however, carry no predictive power. This holds for economic models generally but especially for existing projections of water requirements.

Against this lack of predictive power of models must be weighed the fact that for the individual case for which a model is designed it gives a more precise and frequently a "better"—in terms of outcome—projection than a prediction based on lawlike generalizations. This superiority of

[12] There is, of course, no implication here that measurement is not necessary in science in order to ascertain "reasonable agreement" between theory and observation. Measurement, however, is commonly thought of as significant not merely for testing but also for the formulation of theories. There is some doubt whether in the formulation of theories—that is, in the creative act of innovation—quantitative data are so superior to qualitative ones as is generally supposed in contemporary literature. Support for this doubt has recently come from a historian of modern physical science: Thomas S. Kuhn, "The Function of Measurement in Modern Physical Science," paper presented at the conference on the History of Quantification in the Sciences, New York, Nov. 20-21, 1959, sponsored by the Joint Committee on the History of Science, National Research Council and Social Science Research Council, 23 p., processed.

[13] Alfred Marshall, *Principles of Economics* (8th ed.; London: Macmillan and Co., 1930), 871 p., espec. Book 5.

H. D. Henderson, *Supply and Demand* (New York: Harcourt, Brace, and Co., 1922), Chapter 2, 181 p.

J. R. Hicks, *A Revision of Demand Theory* (Oxford: Clarendon Press, 1956), 196 p.

models, however, depends on their completeness. In this respect, as just noted, existing projections of water requirements are especially deficient. One may add that a prophecy also may happen to be a better projection than a prediction based on lawlike generalizations.

4. *Relevance of Water Requirement Projections for Water Policy*

To question the validity of water requirement projections in terms of criteria for predictability implicitly raises a question of relevance. Projections based on lawlike generalizations—for example, on the demand laws—would be on a quantification level far lower than that of existing water requirement projections (Section 3). We may ask, therefore, what quantitative level is relevant for the purposes for which the projections are made.

One may postulate that the main purpose of projections in water economics is to serve as a basis for public water policy. This is a far more comprehensive field of study than that of public water projects. The economics of water projects—such as benefit-cost analysis, other quantitative techniques of evaluating such projects, and the whole problem of efficiency in government investment—comprise only a segment, and sometimes only a small segment, of water policy.

Reasons for this proposition are not far to seek. As noted (Section 2), in this country—and this is true also for most countries of western society—water is largely allocated and developed through decentralized decision making of self-supplying firms and nonprofit water organizations. These agents are the subsectors in operating the water economy. Individual federal and state projects may be regarded as subsectors in this sense, subject to "rules of the game" not greatly different from those applying to other subsectors. These rules become operational through water institutions—such as water law proper and the laws and regulations under which nonprofit water organizations are established and managed. These rules of the game and their modification are the domain of water policy.

At first glance, the rules of the game with which water policy is concerned could be taken one by one or set by set, introduced as alternative institutional constraints into economic analysis and the paraphernalia of optimizing applied. This is the procedure in most of the many current studies on optimum water resource development. In this procedure, institutional constraints are treated in the same way as the technological ones. Only too often, investigators are not aware of the severe limitations which this procedure imposes on the relevance of quantitative optimizing if the results are to serve as a basis for decision making in public policy. To me, at least, the implications seem so important that several of them need to be explored in the present context.

First, when social institutions are used as constraints, they become conceptually indistinguishable from social objectives. In this respect, they are

different from technological constraints. As explained elsewhere,[14] in natural resource policy, changes of social institutions are among the most significant controllable variables and relations. In natural resource policy, as a field of scientific inquiry, the attitude towards social institutions is pragmatic.[15] In other words, institutions must frequently be regarded as means (tools) rather than ends (objectives) of policy. Hence, the distinction in econometrics between the part of the model that constitutes the "objective function" to be maximized or minimized and the part that constitutes the constraints describing the structure of the operation and the relations between variables becomes misleading if the conceptual difference between technological and institutional constraints is not sufficiently recognized.

Secondly, when social institutions are used as constraints in a quantitative optimizing calculus, a new optimum must be calculated for each combination of constraints that is considered. The optima calculated for different sets of constraints are then compared. Recently, a whole literature has grown up around this approach known as "the theory of second best."[16] This term merely indicates that there is at least one constraint additional to the ones existing in the "Pareto optimum."[17]

The exponents of this theory claim that the major contribution is a negative one: If a deviation from one of the Pareto optimum conditions prevails, the best course of action is not an attempt to attack this deviation and keep all others intact. On the contrary, a second-best solution is usually obtained only by departing from all other Pareto conditions. To apply only a part of the Pareto optimum conditions would move the economy away from rather than toward a second-best position. In consequence, the exponents of this theory direct their criticism against what they call "piecemeal welfare economics."

If this criticism is valid—I believe it has some merit—does it not point to a basic weakness in the logic of quantitative optimizing itself? If one tries to avoid the futility of piecemeal welfare economics and strives for bold changes in the combination of constraints, can one be sure that quantitative optima are comparable in a meaningful way? Is it not unavoidable

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[14] S. V. Ciriacy-Wantrup, *Resource Conservation Economics and Policies* (Berkeley: Univ. of California Press, 1952), espec. Chap. 16-21.

[15] For a recent statement on the schism between "orthodox" and "pragmatic" attitudes toward social institutions, see: F. O. Sargent, "A Methodological Schism in Agricultural Economics," *Canadian J. of Agr. Econ.*, 8:45-52, 1960.

[16] R. G. Lipsey and R. K. Lancaster, "The General Theory of Second Best," *Rev. of Econ. Studies*, vol. XXIV (1), no. 63, 1956-1957, pp. 11-32. The earlier literature is cited in this article.

[17] Vilfredo Pareto, *Cours d'Economique Politique* (Lausanne: F Route, Libraire-Editeur, 1897).

An excellent bibliography of welfare economics is appended to: E. J. Mishan, "A Survey of Welfare Economics, 1939-1959," *The Economic Journal*, 70:197-265, June 1960.

that such bold changes affect the "givens" of the optimizing calculus—among them especially preferences, technology, and the motivation of human agents in their various functions in the economy? Are we not confronted with a problem of identification, in the econometric sense, on a grand scale?

In view of these questions, a somewhat different approach may be explored. I should like to submit that the rules of the game with which policy is concerned should not be used one by one or set by set and introduced into economic analysis as constraints. Rather, these rules constitute structured systems that function as wholes, each with particular patterns of change over time. These systems can be studied in structure, functioning, performance, and change over time. They are created by men and can be modified through the legislative, the judiciary, and the executive branches of government, each with a different range over which such modification can be accomplished.

The purpose of these systems is not to obtain quantitative optima of welfare at given points in time under given conditions projected for these points. Rather, their purpose is to maintain and increase welfare continuously under constantly changing conditions that at any point in time can be projected only vaguely and are always uncertain with respect to actual occurrence. Responsiveness of these systems to economic change is more relevant than their effectiveness in optimizing welfare under a particular set of actual or projected conditions.

It follows that to appraise the performance of these systems by introducing arbitrary temporal cross sections of them—either actual or hypothetical—as alternative combinations of constraints in a quantitative optimizing calculus is inadequate. Performance can be appraised only by criteria applied to a whole system as it functions over time. Such criteria need not be pecuniary. For the system that is of special interest for this paper, namely, water law, it has been shown elsewhere that nonpecuniary criteria, such as security against legal, physical, and tenure uncertainties and flexibility in its various legal and economic categories, can effectively be employed.[18] Such an appraisal is an integral part of economics that includes econometrics but is not restricted to it.

5. *Water Allocation Policy*

For analyzing further what kind of projections are relevant for water policy, I should like to deal first with water allocation and then with water development. In political reality, decisions in these two spheres are closely related. In economic analysis, it is useful to separate them.

[18] S. V. Ciriacy-Wantrup, "Concepts Used as Economic Criteria for a System of Water Rights," *Land Economics*, 32:295-312, Nov. 1956. Also published in: *The Law of Water Allocation in the Eastern United States*, ed. David Haber and Stephen W. Bergen (New York: The Ronald Press Co., 1958), pp. 531-52.

In the arid and semiarid regions in this country and elsewhere, water allocation among uses and users has always been a policy problem under greatly changing conditions affecting the aggregate quantity of water used and the quantitative relations between uses. In the beginning of water development—for example, in the "gold rush" days in the Mother Lode country of California—water allocation was such a problem when all uses, including agricultural, were small but when industrial use, namely, hydraulic mining, was the dominant one. In present day California, water allocation is such a problem, even though other uses are a fraction of a quantitatively dominant agricultural use. [19] Since water allocation is always vital for societies in arid and semiarid regions, numerous institutional arrangements have been developed which govern it.

If one wants to undertake an economic appraisal of the allocative functions of this system, one cannot be content with appraising quantitative allocation prevailing at a particular point of time. What needs to be appraised is the direction and speed of reallocation in response to economic change. Improvements in these respects are the main policy objectives. The first step toward such improvements is an understanding of the existing system and of the process of its change. Each state is a laboratory in which this system has developed and is still developing. When individual provisions are modified, such changes must be fitted into the whole system. If the system as a whole is judged inadequate, a better substitute must be offered. Only too often, criticism of water allocation at a particular point of time is voiced by economists without regard to the nature of the decision problems that water allocation poses for policy. Optimizing as a fictional construct is confused with an actual policy objective.[20]

As an illustration, let us focus on four facts already alluded to : (1) that water law in the West has developed with and around the growth of agriculture; (2) that agricultural water use is now quantitatively dominant;

[19] For comparing different uses quantitatively, two factors are frequently not sufficiently considered: (1) whether conveyance losses are included or excluded for agricultural use and (2) whether water use by steam electric plants—the quantitatively most significant one among industrial uses—is included or excluded for industrial use. In California, for example, agricultural use is 87 per cent; industrial use, 5 per cent; and domestic use, 8 per cent of total use if conveyance losses are included and steam electric plants excluded. Agricultural use is 67 per cent; industrial use, 25 per cent; and domestic use, 8 per cent if conveyance losses are excluded and steam electric plants are included. In terms of water consumption, the former is a more appropriate comparison, provided that double counting is avoided. Some conveyance losses are used via ground water and counted then. On the other hand, there is considerable interfirm reuse of water both in agricultural and industrial use. The quantitative extent of such reuse is not known. Steam electric plants use, largely, cooling water that is not usable for other purposes and, in any event, is not consumed. Potentially, of course, most domestic use can be made nonconsumptive. (See also footnote 5.)

[20] The usefulness of optimizing as a fictional construct is discussed in: S. V. Ciriacy-Wantrup, "Policy Considerations in Farm Management Research in the Decade Ahead," *J. Farm Econ.*, 38:1301-11, Dec. 1956.

(3) that nonagricultural water uses are increasing at a rate greater than agricultural use; and (4) that water is used in agriculture with relatively low average value productivity. Do these four facts indicate that western water law misallocates water to the advantage of agriculture as is commonly alleged? I believe the answer must be negative or, in more guarded terms, "not necessarily."

As to the past, only a fraction of present water development would exist if agricultural use had not become dominant. In other words, no large quantities of developed water would be available now for reallocation. As to the present, the relevant criterion, as we know, is not whether misallocation exists at the moment, but whether continuous reallocation is too slow. As to relative value productivities of water in different uses, it is the marginal and not the average value productivity that is the proper basis for continuous reallocation. The figures that are presented in the literature refer to average values frequently aggregating over highly dissimilar situations. If one wanted to be facetious, one could say that the average value productivity of water in nonagricultural uses would be negative if the whole or a large portion of agricultural water were to be reallocated to nonagricultural uses. Moreover, care must be exercised that marginal productivities are taken at comparable stages of water distribution and refinement. Agriculture uses water wholesale and largely unrefined. Domestic use, on the other extreme, is retail and frequently refined. Costs of water distribution and refinement are by far the largest items in the retail water bill.

The indictment of misallocation then boils down to an allegation that the rate of water reallocation from agricultural to nonagricultural uses is too slow. Invariably, this allegation is based on two structural elements of western water law: (1) preference of agricultural over industrial use in most states and (2) priority in time of agricultural use that becomes relevant in those states operating under water laws based on the appropriation doctrine.

It is true that the statutory preference given to agricultural over industrial use is obsolete. I have gone on record to that effect on previous occasions.[21] I suggested then to eliminate statutory preference altogether and to leave to the courts or special water rights boards the determination of which is the higher use in each situation of conflict. On the other hand, the economic significance of agricultural preference and priority is already limited by other provisions in western water law. There are no less than seven of these that are relevant.

First, municipal use has preference over agricultural use. A large part of municipal water use is for commercial and industrial purposes, although it is difficult to differentiate this part statistically from domestic use.

[21] S. V. Ciriacy-Wantrup, "Some Economic Issues in Water Right," *J. Farm Econ.*, 27:875-85, Dec. 1955.

Second, under several state laws, municipal water use enjoys the right of water reservation. This means that municipalities can hold water rights for future rather than present need without being subject to the due diligence clause that is such an important part of the appropriation doctrine.

Third, municipalities can acquire agricultural water rights through eminent domain proceedings. Frequently, the mere threat of such proceedings is sufficient. The Owens Valley in California is an example.

Fourth, in most states, many industrial self-suppliers rely on riparian and correlative ground water rights rather than appropriative rights. They are, therefore, not affected by the preference and priority clauses of appropriation law.

Fifth, water organizations such as irrigation districts and the Bureau of Reclamation that originally developed water under agricultural preferences and priorities now deliver water and hydroelectric power on a large scale for industrial and municipal purposes. Irrigation district laws have been adapted to permit such deliveries. Often, industrial and municipal uses take place on the same acreage where irrigation agriculture has been replaced by urban development. Per-acre requirements of irrigation agriculture are more than sufficient to cover those of "higher" uses. This is an example of what was suggested above: namely that water development historically undertaken mainly for agriculture is now of direct benefit for other uses.

Sixth, water development itself tends to reduce the economic significance of the superiority of a senior over a junior right under appropriation. This superiority is based mainly on greater security against "physical uncertainty"—as distinct from "tenure uncertainty"—that is, against variability over time of the quantity of water usable under the right due to seasonal or annual variability of natural runoff and ground water recharge. Storage above and below ground is the major technical possibility of reducing physical uncertainty. After storage capacity has been provided and is managed with a view to reducing physical uncertainty, the relative economic status among senior and junior rights changes without changes in their relative legal status.

This situation is related to my seventh and last point. Water rights are increasingly vested in nonprofit water organizations such as districts, federal bureaus, and state water departments. Contracts between water users and these organizations rather than private water rights become the operationally important aspect of water allocation. These organizations do not serve agriculture alone and can reallocate water over time under the terms of the contracts by following appropriate statutory procedures.[22]

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[22] Stephen C. Smith, "Legal and Institutional Controls in Water Allocation," *J. Farm Econ.*, 42:1345-58, Dec. 1960.

Stephen C. Smith, "Resource Policies and the Changing West," *Land Economics*, 36:22-34, Feb. 1960.

Space does not permit more than a sketch of these seven points. Enough has been said to illustrate the proposition that economists should carefully study the actual functioning and performance of water law before far-reaching conclusions with respect to failure to optimize water allocation are drawn from two structural elements.

This does not imply, of course, that a given temporal cross section of water law in a given place (state) is perfect or even that, over time, water law is adapting to economic change at an adequate rate. Economists should be continually alert for possible improvements in water law. While economics cannot define quantitative optima of water allocation which the law—as "social engineering"—should aim to realize, economics can determine whether and explain why the reallocative performance of water law is too slow. This area of water policy is a promising field for cooperative research between the economist and the student of law.

Much can be learned from observing historically the allocative performance of water institutions in relation to changes of demand for different uses. The results of this comparison can be used for institutional change. Changes in the allocative system can also be made in anticipation of the above general characteristics of demand changes that can be projected. On the other hand, precise quantitative projections of water requirements for different uses are not relevant for water allocation policy. Such projections merely beg the question.

6. *Water Development Policy*

Water development policy was differentiated from water development projects (Section 4). This paper is concerned with the former. The economics of public investment in water projects has been discussed elsewhere.[23]

Water development policy, like water allocation policy, becomes operative mainly through water institutions. But different aspects of institutions are involved. Among these, several may be mentioned. First, there is the blend in state water laws between riparian and appropriation doctrines; this blend is significant because the riparian doctrine is relatively less favorable to water development—with one important exception to be discussed presently. There are, second, the laws concerning water reservations for future development by particular uses and regions; municipal reservations and the area of origin legislation in California are examples. Third, there are the antipollution laws that affect the broad field of water quality management; this field becomes increasingly significant as water development is intensified and natural purification processes are over-

[23] S. V. Ciriacy-Wantrup, "Cost Allocation in Relation to Western Water Policies," *J. Farm Econ.*, 36:108-29, Feb. 1954.

S. V. Ciriacy-Wantrup, "Benefit-Cost Analysis and Public Resource Development," *J. Farm Econ.*, 37:676-89, Nov. 1955.

loaded. Fourth, there are the laws establishing and regulating water organizations; the problems of coordinating these organizations through "superdistricts" has become especially acute for water development. These problems are related to a fifth aspect which may be selected here for more detailed discussion because of its implications for water requirement projections (Section 2). This aspect is ground water law and the need for integrating ground water development with that of surface water.

The recent economic literature on water development focuses on the efficiency of public investment in water projects. When this focus becomes dominant, it must be diagnosed as a myopia that overlooks the significance of ground water development. Ground water is developed largely by private investment. The quantitative significance of ground water development may be illustrated with a few figures.

Ground water development was responsible for 67 per cent of total public and private irrigation development in the 17 western states since 1940. If federal water development is excluded, this figure rises to 89 per cent. The share of ground water development by decades is also interesting. Before 1900, ground water was responsible for only 1 per cent of total public and private irrigation development in the 17 western states. Between 1900 and 1909, this percentage was 8 per cent; from 1910 to 1919, 27 per cent; from 1920 to 1929, 52 per cent; from 1930 to 1939, 42 per cent; from 1940 to 1949, 63 per cent; from 1950 to 1958, 69 per cent.[24]

Ground water development is a major reason for the significance of self-supply in the water supply picture of agriculture mentioned previously. Ground water development, being based on private investment, decreased absolutely and even more so relatively during the depression decade in agriculture, 1930-1939. During this decade, federal water development, which consists largely of storage of surface runoff, showed a strong increase. We may also note that for industrial water use surface water development is more important than ground water development. For industry, the locational attraction to surface water is explained largely through the adequacy of "free" brackish and sea water for steam electric plants,[25] through the effects of navigable waters on costs of transportation, and through facilities offered by large bodies of water for waste disposal. Availability of water for consumption is incidental to these other water uses.

It was explained why the increasing significance of ground water development over the last half century makes hazardous any projections of water requirements through extrapolating past trends of water use (Section 2). However, overdraft on ground water may be used for a somewhat different kind of projection: for projecting the requirements for surface

[24] Computed from data given in: U. S. Congress, Senate, Select Committee on National Water Resources, *Water Resources Activities in the United States: Future Needs for Reclamation in the Western States, op. cit.*

[25] See footnotes 5 and 19.

water development in order to put economic development based on ground water overdraft on a firm foundation with respect to the water economy.

The economist cannot accept the necessity of such stabilization as a foregone conclusion. But there are economic reasons for expecting that the benefits of surface water development undertaken mainly for stabilizing ground water development are relatively high. Surface water development for "new" uses can then be regarded as a joint product of firming up "old" ground water uses and can be treated in benefit-cost analysis accordingly. Some features of the California State Water Plan are of this kind.

Use of overdraft for quantitative water requirement projections is, however, not as significant for the integrated development of ground with surface water as appropriate institutional arrangements. Ground water law, where based on riparian ideology such as the correlative rights doctrine developed mainly in California, has been an important factor in permitting overdevelopment (in the physical sense of overdraft). This is the exception to the rule that the riparian doctrine is less favorable to water development than the appropriation doctrine. On the other hand, after adjudication of a ground water basin, correlative rights acquire the economic characteristics of appropriation rights. They become quantitatively defined, transferable, and secure against tenure uncertainty.

At first glance, ground water rights could be transferred without adjudication to the water organization that imports the surface water. This water organization would then allocate quantities of ground or surface water or combinations of the two to individual users. If pumping is done by individual users, they would be appropriately compensated since overdraft during extended periods of time is an essential part of integrated development of ground water with surface water. The most important resource of a ground water basin—namely, its storage capacity—could then be utilized to counteract seasonal and cyclical variability of precipitation without a complex system of price and other inducements that would become necessary if all rights to ground and surface water were not held by the same water organization.

There is some question whether private ground water rights will be surrendered voluntarily in this way without prior adjudication. Ground water rights are valuable private property rights because local ground water is generally much cheaper than imported surface water. Owners, therefore, will not be willing to surrender these rights without quantative definition and adequate compensation. Such definition and compensation also become necessary if private ground water rights are taken by the water organization through eminent domain proceedings.

The problem of private ground water rights is only one aspect of a water development policy aimed at integration of ground and surface water.

Another aspect is the establishment, regulation, and supervision of the type of water organization that actually does the integrating. It is fairly clear that water organizations of sufficient size are needed to cover the ground water basin that is to be managed and to import and distribute adequate quantities of surface water. If present water organizations are not of sufficient size, the question arises whether they should amalgamate or whether they should federate and form a superdistrict within which each organization would still maintain a degree of independence. The trend, I believe, is toward superdistricts. The most outstanding example in terms of size is the Metropolitan Water District of Southern California, in which the municipal water organization of Los Angeles is the most important member. There are others of this kind in California and elsewhere.

What is the implication of such superdistricts for the state that establishes, regulates, and supervises them? Some students feel that water development in the West is an undertaking too big for even the largest superdistricts and that it should be undertaken by the state. Others feel that superdistricts have become so big financially and politically that the state should step into direct water development through planning, constructing, and operating projects in order to preserve balance in the rate of water development between the various regions of the state. Still others feel that statewide water development should be left to the interaction of water organizations including superdistricts, that the state should stay out of direct water development, and that in such a less involved position it could more effectively play its important role as the locus of water development policy in the sense in which the word is used in this paper.

These and other views on appropriate institutional arrangements for integrated ground and surface water development are in conflict. This conflict is acute in California. It is mentioned not in order to take sides but to suggest that some of the crucial issues of water development are in this area. With water development policy, as with water allocation policy, the functioning, performance, and change over time of an institutional system is involved rather than quantitative optimizing at given points in time under projected conditions.

Research in this area need not return to the descriptive approach to water institutions. There is now considerable historical evidence on water institutions that can be approached analytically by the social sciences. An analysis of the structure, functioning, performance, and change over time of superdistricts is an example. Such studies can be extended to other countries where interesting material is available. Last year, I had occasion to study the Metropolitan Water District of the Ruhr comprising Germany's industrial heartland. This district has been in successful operation since 1913. Some of the same problems now faced in this country, such as the relation between superdistricts and state, have been solved there.

On the other hand, how helpful in this area of water development are any or all of the many water requirement projections for the year 2000 or the quantitative programming of optimum water development for which arbitrary sets of these institutional arrangements have been employed as constraints? For some narrower problems of water development, especially in the economics of individual public projects, such studies have a place. But it would be unfortunate if the current concentration of effort in this direction should lead to the neglect of the crucial issues of water development policy. For dealing with these issues, an analytically oriented institutional economics is by no means obsolete.

THE ECONOMICS OF COOPERATIVE VENTURES—FURTHER COMMENTS

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THE feeling that many cooperative thinkers had not fully exploited the modern advances of economic theory led to some rather novel formulations of an economic theory of cooperation, notably by I. V. Emelianoff[1] and by R. Phillips.[2] While Dr. Emelianoff mainly laid out an extensive scheme of economic morphology, Professor Phillips has offered an adaptation of "the contemporary theory of the firm" to the cooperative structure as defined in the former's morphology. In subsequent notes by Dr. J. Savage[3] and Professor O. Aresvik[4] respectively, criticism was expressed of Professor Phillips' theory, largely on the score that it attempts to generate normative rules by economic reasoning, and that its tight analogy of cooperation with vertical integration leads to some erroneous conclusions. Whereas these criticisms reveal apparently genuine weaknesses in the theory in question, they do not seem to have offered sufficient answers to all its problematic issues. I therefore venture to offer the ensuing comments as a supplement to the various contributions that have been hitherto made on the economics of cooperation, but with no aspiration to exhaust the field. In particular, attention will be given below to the analogy of cooperation with vertical integration, to the concept of an economic equilibrium in a cooperative association, and to the controversy over the matter of entrepreneurship.

The Morphological Nature of Cooperatives and Vertical Integration

Economic morphology in this context is used in reference to the variety of institutional (as distinct from technological) links between individual plants in the economy. Dr. Emelianoff regarded a cooperative as an "aggregate of economic units" coordinating their activities, but each fully retaining its economic individuality and independence; the aggregate is "an agency of the associated units, owned and controlled by them, through which they conduct their business activities" (*op. cit.*, p. 248). Further, "an aggregate is functioning only as a branch or part of associ-

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[1] *Economic Theory of Cooperation*, Washington, D.C., 1948.

[2] "Economic Nature of the Cooperative Association," *J. Farm Econ.*, Feb. 1953, pp. 74-87. I do not mention here the many excellent publications by other writers, dealing with economic issues in cooperation but not primarily in the context of a formal theory.

[3] "Comment on 'Economic Nature of the Cooperative Association,'" *J. Farm Econ.*, Aug. 1954, pp. 529-34.

[4] "Comments on 'Economic Nature of the Cooperative Association,'" *J. Farm Econ.*, Feb. 1955, pp. 140-44.

ated economic units"; therefore, a cooperative as an aggregate "is perfectly identical with the special departments and branches of single economic units" (*ibid.*, p. 249). The same view was subsequently advanced by Professor Phillips, who drew a distinction between the cooperative association on the one hand and the cooperative plant ("activity") on the other. The latter has no "economic life" of its own, and should rather be conceived as a part of each participating firm by the following rule: "The proportion of the total joint plant included as a part of each participating firm is defined by the relative size of the production activities in the individual plant of each firm with which the activities conducted through the joint plant are integrated" (*op. cit.*, p. 77). From this premise Professor Phillips is led to regard each participating firm as a multi-plant firm, and consequently to derive some conclusions about profit maximization which, as we shall see, are not wholly consistent with the original premise itself. Before turning to inferences, however, let us review the merits of the fundamental analogy.

The unique attribute of an integrated plant (and of a branch or department for that matter) is its subjugation to external economic control, in the sense that it cannot pursue maximum profit for itself, but rather has to orientate its economic activities towards the ultimate profit-objective of a broader organization. Even if an integrated plant is not run directly from a "central office," but rather is given a great measure of autonomy for efficiency's sake, its own pursuit of profits must not undermine simliar efforts by other affiliated plants. Hence individual plants which are horizontally integrated (in the narrow sense of the word) will not conceivably engage in economic rivalry against each other, nor will vertically integrated plants conceivably attempt to exploit one another economically.

Similarly, when independent operators in one industry found a cooperative plant in an adjacent industry, to patronize and control by a majority of votes, the cooperative plant has no profit motive of its own, and its patrons as a *group* can dictate to it what courses of action to follow. As a group, the member-patrons regard the cooperative as a utility-enterprise to supplement their independent ventures, and have no fear of economic exploitation on its part. However, none of the member patrons individually faces the cooperative plant as a "central office" faces one of its branches or integrated enterprises. Each of them, while seeking the greatest advantage from the use of the cooperative, has to reconcile his own self-centered pursuit of profit with that of the other member-patrons. Whereas an integrated plant serves a single economic interest, confronting one locus of profit maximization, a cooperative plant serves simultaneously several separate interests, which may complement one another, supplement one another, and even conflict with one another,

according to whether at any given state, subject to the rules of participation, an adjustment of some kind by one or some patrons (including new entrants) will benefit, leave unaffected, or "penalize" the rest.

Let us, for instance, consider in broad terms the inter-relationship of interests in a cooperative relative to marginal changes in the total volume of patronage, assuming no deviation from the rule of patronage dividends. (Similar considerations, subject to rules of participation, are conceivable relative to changes in the composition of goods that the cooperative handles, in the geographical spread of its activity, in its method of finance, and so on.) On the production or processing side of the joint enterprise, complementarity will prevail over phases of diminishing unit-costs (particularly where cooperation is primarily motivated by the desire of small operators to relinquish one of their traditional functions to a new specialized, mass-producing industry, or by the desire of small operators to enter an established mass-producing industry in order to circumvent monopolistic or monopsonistic exploitation), supplementarity will prevail over phases of constant unit-costs, and conflict will prevail over phases of rapidly rising unit-costs (resulting from exhaustion of inflexible capacity, especially under a severe resource restriction). On the market side of the joint enterprise, supplementarity will prevail where the prices that the cooperative pays (procuring goods for its members) or obtains (selling on their behalf) are not affected by its volume of trade; otherwise conflict will prevail, which will become increasingly more acute as the number of operators in the patrons' industry continuously declines. (Obviously the exact gains of individuals from cooperation in case of conflict—in the sense used here—depend on a compromise that can be attained within the association.)

This variability of economic inter-relationships in a cooperative association, due to the structure of the relevant markets, the technology of production, resource limitations, and other factors, must play an explicit role in the formulation of an economic theory of cooperation, for it bears upon such issues as the equilibrium in a cooperative enterprise, the role of its management, the propensity to cooperate, and the appeal to individual patrons of particular rules from the cooperative heritage (as a matter of consistency with profit maximization under the given circumstances).[5] In general, the plurality of interests, which draws a distinct border line between cooperation on the one hand and vertical integration on the other, renders the conventional economic theory of multi-

[5] The ensuing discussion is devoted mainly to the first two issues. However, since the question of a cooperative equilibrium can be treated only relative to a given set of rules of participation, we shall inevitably, at least by implication, touch upon possible economic consequences for members of individual institutional arrangements, such as free entry for new patrons, and the dissociation of voting rights from the contribution of capital, given the rule of patronage dividends.

plant firms quite inapplicable to the former. Instead, it appears that for a fruitful analogy one should resort to the less developed theory of collective utilities (a "utility" representing union between patronage and control), which vary all the way from the private subsidiaries of cartels to public utilities. This will become more apparent from the ensuing discussion concerning the economic equilibrium in a cooperative association.

About the Economic Equilibrium in a Cooperative Association

The criteria for an economic equilibrium in a cooperative association that have been proposed respectively by Professor Phillips and Professor Aresvik rest on an implicit assumption that patronage of the cooperative plant by its members is "exclusive," in the sense that neither do members patronize competing enterprises nor do non-members patronize the cooperative plant. This assumption will also underlie all the ensuing arguments concerning the equilibrium, because the union of patronage and control is a fundamental attribute of cooperation, and for those instances where such union is not maintained in its perfect form, the arguments can be easily modified. Both analyses were also said, in one context or another, to rely on the assumption that all the costs incurred by a cooperative enterprise and all the revenues obtained by it are shared by all the members in proportion to patronage.[6] This fundamental premise, too, will underlie the ensuing comments. With these assumptions in mind, let us approach the matter of a cooperative equilibrium through the path that has already been trodden.

Having closely analogued cooperation with vertical integration, Professor Phillips used the model of a multi-plant firm to derive the following necessary conditions for an economic equilibrium in the use of a cooperative plant:

(1) Regarding the allocation of resources: "For each participating firm the marginal productivity of each resource allocated to the cooperative plant must be equal to the marginal productivity of that resource in the individual plants of that member firm" (*op. cit.*, p. 75).

(2) Regarding the volume of patronage: "The cooperating firm equates the sum of the marginal cost in its individual plant or plants and the marginal cost in the joint plant with the marginal revenue facing the firm in the market where the product is sold. . . . Each entrepreneur must consider the additional costs in the joint plant resulting from his volume of output" (*ibid.*, pp.. 79-80). When this is done simultaneously by all members, patronage reaches its optimal scale. "If the output of the participating firms is marketed from their joint plants," the condition has to be modified, such as to equate the sum of the marginal costs as previously specified to the marginal revenue obtainable by the cooperative.

Let us, for the sake of convenience, express the different variables in

[6] See Phillips, *op. cit.*, p. 77, and Aresvik, *op. cit.*, p. 141.

algebraic symbols. Using capital letters to designate variables of the cooperative plant and small letters to designate variables of the individual plants, we can write *MVP* and *mvp* for marginal value productivity, *MC* and *mc* for marginal cost, and *MR* and *mr* for marginal revenue, and then express Professor Phillips' conditions as follows:

(1) $mvp_{ji} = MVP_j$ for any factor j and firm i.

(2a) For a procurement cooperative, $mc_{ik} + MC_l = mr_{ik}$, for any firm i producing commodity k from output l of the cooperative.

(2b) For a marketing or a processing cooperative, $mc_{ik} + MC_l = MR_l$, for any firm i producing commodity k for output l of the cooperative. MC_l in (2a) and $(MR_l - MC_l)$ in (2b) must, of course, be expressed as functions in k rather than in l, to permit the comparison.

In his comments on Professor Phillips' theory, Professor Aresvik does not deal with condition (1), but makes the following observation with regard to conditions (2a) and (2b):

> The marginal cost a member firm faces in the joint plant is the average cost in the joint plant, and the marginal return a participating firm faces in a marketing cooperative association is the average return in the joint plant. Therefore, under the assumption of profit maximization, a participating firm in a marketing cooperative association equates the sum of the marginal cost in its individual plant or plants, plus the average cost in the joint plant with the average revenue facing the joint plant in the market where the product is sold (*op. cit.*, p. 141).

To state Professor Aresvik's conditions algebraically, writing *AC* and *AR* for average cost and revenue respectively, we have: For a procurement cooperative,

(2′a) $$mc_{ik} + AC_l = mr_{ik},$$

for any firm i producing commodity k from output l of the cooperative; and for a marketing (or processing) cooperative,

(2′b) $$mc_{ik} + AC_l = AR_l,$$

for any firm i producing commodity k for output l of the cooperative.

Professor Aresvik contends, rightly it seems, that Professor Phillips' conditions are inconsistent with his own model, although he does not specify the contradiction. The conditions of the latter implicitly presuppose that every member in a cooperative bears *in full* all the additional costs that the cooperative plant incurs as a result of a small increase in his patronage, and receives *in full* the additional revenue that the cooperative consequently obtains in the open market. This implicit presupposition, as we shall presently see, is inconsistent with the fundamental assumption that all the costs that the cooperative plant incurs and all the revenues that it obtains are borne by all the members in proportion to patronage. The latter practice, in fact, implies that the cost for each member of patronizing a procurement cooperative per unit of the commodity procured is equal to the average total cost of the cooperative,

and the revenue from patronizing a marketing (or processing) cooperative per unit of the commodity delivered is equal to the average revenue of the cooperative minus its average total costs of handling (or processing). Hence, AC_l of a procurement cooperative and $(AR_l - AC_l)$ of a marketing cooperative (both expressed as a function in k), represent invariably the *average* cost and revenue facing the individual member, but not his *marginal* cost and revenue as suggested in Professor Aresvik's critique. In a subsequent note Professor Aresvik qualified his original conditions as applying only where "the member firms behave like quantity adjusters," and so made them more acceptable.[7] But the qualified conditions now pertain to a special (though by no means rare) case, rather than possess the generality which Professor Phillips had attempted.

In order to allow at once for various situations that may arise in a cooperative, it seems desirable to express in the form of a general identity the exact definition of the marginal cost and revenue that confront individual patrons in the joint enterprise. This identity must hold for cooperatives of any number of participants and of any measure of control over their markets, and must be directly derived from the premise that the total costs and revenue of the joint enterprise are shared by members in proportion to patronage. Such derivation is shown below, treating first conditions (2a) and (2b), which concern changes in the level of patronage, and subsequently condition (1), which concerns resource allocation between the cooperative plant on the one hand and its members' plants on the other. For simplicity, we shall assume throughout that patronage involves a single commodity, or a bundle of commodities which can be expressed in terms of a single index.

Consider initially a procurement cooperative which incurs a total outlay C in the open market while supplying its members with a total output V, and an outlay p_sS on members' capital, where p_s represents a fixed rate of return on such capital for the period under consideration, and S represents the sum of capital contributions by members. Then the ith member, with a volume of patronage v_i and capital investment s_i, pays for his supplies from the cooperative over the specific period a total net amount c_i, as follows:

$$\text{I} \qquad c_i = \frac{(C + p_sS)v_i}{V} - p_ss_i.$$

As the payments on members' capital are in the end self-cancelling it is easily seen that $\sum_i c_i = C$, and thus C can be spoken of as the total *real* outlay of the cooperative plant, while $(C + p_sS)$ depicts the total *nominal* costs.

[7] "Member Behaviour and Optimal Pricing in Marketing Cooperatives," *J. Farm Econ.*, Feb. 1957, pp. 169-72.

Assuming at this stage that S remains constant while V varies (namely, that members are not required to increase their capital contributions as their patronage expands), we can describe C alone as a function of V, and write MC_v for $(C_{v+\Delta v} - C_v)$, where ΔV is an incremental change in patronage. For the ith member, therefore, who moves from v_i to $(v_i + \Delta V)$, while the patronage of the other members remains unchanged, we can write the new sum of total costs as

$$\text{II} \qquad c_i + \Delta c_i = \frac{(C_v + MC_v + p_s S)(v_i + \Delta V)}{(V + \Delta V)} - p_s s_i,$$

and if we deduct identity I from identiy II, we have:

$$\text{III} \qquad \Delta c_i = MC_v\left(\frac{v_i + \Delta V}{V + \Delta V}\right) + (C_v + p_s S)\left(\frac{v_i + \Delta V}{V + \Delta V} - \frac{v_i}{V}\right).$$

Identity III represents the marginal cost of the ith member, resulting from an incremental rise in his patronage. Verbally, this marginal cost for the ith member is equal to [the corresponding marginal cost of the cooperative] times [the modified patronage ratio of that member] plus [the total cooperative outlay before the expansion] times [the excess of the new patronage ratio of the ith member over the old]. This result is significant. It means that the ith member, upon an incremental expansion of his patronage, bears only a portion of the additional cost to the cooperative, relative to his new share of patronage; but in addition he assumes a larger share of the initial costs, because his relative share of patronage has now risen. Hence, Professor Phillips' relevant condition (2a) has to be restated as

$$(2''\text{a}) \qquad mc_{ik} + mc_{il} = mr_{ik},$$

where mc_{il} is ΔC_i in identity III, namely the marginal cost that the ith member will have to incur in procuring a small additional amount of commodity l from his cooperative.

This modified equality describes a state where the ith patron of a procurement cooperative, other things being equal, will cease adjusting his patronage, v_i, provided that a sufficient condition is also satisfied that with additional increments of v_i, $(mr_{ik} - mc_{ik})$ is continuously diminishing and mc_{il} is not diminishing faster, or else that mc_{il} is continuously rising with additional increments of v_i and $(mr_{ik} - mc_{ik})$ is not increasing faster. Otherwise, the said equality does not necessarily define a relative optimum for the ith member in the sense that under the circumstances additional expansion of patronage will not pay. It is important to note in this connection that mc_{il}, as can be seen from identity III, may over an initial phase be diminishing even when MC, the marginal cost in the cooperative plant, is always increasing, because the former is a function

not only of the latter, but also of the level of fixed costs in the cooperative plant and of the change in the patronage ratio v_i/V as v_i changes by an increment.[8]

Assuming that every member is bound to reach a point, with the patronage of the other members being momentarily fixed at some level, beyond which further expansion of v_i yields no gains, it is conceivable to have a state where equality (2″a) holds simultaneously for all the patrons. This is a state to which Professor Phillips has referred as the "equilibrium" of the cooperative, and which is marked by the fact that no individual would *independently* attempt further adjustments once the state has been reached. However, cooperatives need not, even in a theoretical context, always gravitate towards this state, nor will the individual patrons necessarily aspire to reach it. The question that we have to consider in this connection is again that of complementarity and conflict.

We have seen above that as the ith member expands his patronage from v_i to $(v_i + \Delta V)$ while the rest of the patrons make no adjustment, c_i increases by an amount Δc_i. How now would the said change affect the outlay of the jth member, c_j, with a constant patronage v_j? It can be shown that as the ith member expands his patronage by an amount ΔV, the outlay of the jth member changes by an amount

$$\Delta c_{j(V|v_j)} = c_{j(V+\Delta V|v_j)} - c_{j(V|v_j)}$$

as follows:

$$\text{V} \qquad \Delta c_{j(V|v_j)} = \frac{v_j}{V+\Delta V}\left[MC_v - \frac{(C_v + p_s S)\Delta V}{V}\right].$$

The expression in parentheses has unique significance. We can define the elasticity of the total nominal costs in the cooperative plant, say EC_v, as

$$EC_v = \frac{MC_v}{C_v + p_s S} : \frac{\Delta V}{V}$$

at any level of total patronage V; then, at points where $EC_v > 1$, the said expression is positive and where $EC_v < 1$, the said expression is negative.

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[8] It is possible to show that if R_v, $R_{v+\Delta v}$, and $R_{v+2\Delta v}$ respectively signify the ratios

$$\frac{v_i}{V}, \quad \frac{v_i + \Delta V}{V + \Delta V}, \quad \text{and} \quad \frac{v_i + 2\Delta V}{V + 2\Delta V},$$

the change in Δc_i in identity III that can be expected with a shift from v_i to $(v_i + \Delta V)$ is given by the following expression:

$$\text{IV} \quad \Delta^2 c_i = (C_v + p_s S)\left[(R_{v+2\Delta v} - R_{v+\Delta v}) - (R_{v+\Delta v} - R_v)\right] + MC_v(R_{v+2\Delta v} - R_{v+\Delta v}) + \left[MC_{v+\Delta v}(R_{v+2\Delta v}) - MC_v(R_{v+\Delta v})\right].$$

Although $(R_{v+2\Delta v} - R_{v+\Delta v})$ is always positive, $\Delta^2 c_i$ can initially be negative even where $MC_{v+\Delta v} > MC_v$ throughout (i.e. where marginal costs in the cooperative plant are always rising) since the multiplier of $(C_v + p_s S)$ is always negative.

Namely, where the total nominal outlay of the cooperative has elasticity larger than unity with respect to the volume of output V, the expansion of the ith member will "penalize" the jth member, and where the said elasticity is smaller than unity, the expansion of the ith member will "subsidize" the jth member, both "penalty" and "subsidy" being borne in proportion to patronage as defined by the ratio $v_j/(V + \Delta V)$. (Evidently a change in the level of patronage of the ith member will affect not only the *total* outlay of the jth member, c_j, whose patronage remains constant, but also his *marginal* procurement cost, Δc_j, for the given v_j.) A reciprocal argument also becomes evident, that by an incremental expansion the ith member incurs an additional cost larger than the marginal cost of the cooperative plant if $EC_v<1$, and smaller if $EC_v>1$, at the initial level of V.[9]

When the cooperative plant operates over a phase of diminishing marginal costs, EC_v is constantly smaller than unity, regardless of the level of fixed costs, and as one member expands, the other members' outlay continuously declines.. Assuming that the respective revenue curves of the patrons are not significantly inter-dependent, under such a circumstance every individual will be allowed to expand his patronage freely, and new members will be encouraged to join the cooperative. However, when the cooperative plant reaches a phase of increasing marginal costs, EC_v will rise and even if initially smaller than unity will ultimately exceed unity and continue rising, depending on the rate at which the marginal cost, MC, increases. It is thus obvious that over an initial range of increasing marginal costs, the expansion of patronage by one member may still be complementary to the interests of the other members, but if the cooperative enterprise operates under a severe limitation of one or more resources, a point must be reached as marginal costs increase where no individual member would desire that the others expand, or, being an "economic man," that new members join the cooperative. The "penalty" of expansion borne by other patrons may not, over some range, be noticeable or significant, but as it becomes noticeable, an inclination may develop among patrons to regulate patronage by some deliberate action. Some process of bargaining will have to take place among the members before a pattern of regulation is established, since all the members have equal voting rights. Generally we can anticipate from identity V that relatively large patrons will be more adamant in their demand for regu-

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[9] This can be clearly seen from the following expression:

$$\text{VI} \qquad MC_v - \Delta c_i = \frac{V - v_i}{V + \Delta V}\left[MC_v - \frac{(C_v + p_s S)\Delta V}{V}\right],$$

where $(V - v_i)$ is naturally the sum of the volumes of patronage of all the members except the ith one.

lation of patronage than relatively small ones, and similarly from identity VI, that, given the total volume of patronage, further expansion of small patrons will be more objectionable than that of large ones. However, if EC_v is sufficiently larger than unity to arouse antagonism, every member will set for himself, as an economic man, an "ideal" target wherefrom he will begin to cede. The *i*th member can calculate for each possible level of v_i that level of V which will minimize c_i;[10] then, considering his derived demand for the particular commodity which the cooperative venture procures, he can ascertain which combination of v_i and V is likely to yield him the highest possible profit as an independent operator, the next highest, and so forth. The resulting array of combinations of v_i and V from the most to the least profitable will mark a path along which the *i*th member will gradually recede as he negotiates with other members for a compromise that can obtain a majority approval. Hence, it is unlikely that under increasing marginal costs in the cooperative plant an attempt to regulate patronage by vote will lead towards the satisfaction of equality (2″a) for all the members. Naturally, where the technical possibility exists, the antagonism within a procurement cooperative may at some critical point be resolved by founding an additional plant. It is further of theoretical interest to note that if circumstances allow a state where equality (2″a) holds simultaneously for all the patrons to be reached by spontaneous expansions, the sum of net profits of the members as a whole will be lower than under a merger of all the patrons' plants whereby the original criterion (2a) can be satisfied.

In the case of a marketing or processing cooperative, the problem of the economic equilibrium becomes more complex, because we can no longer assume that the ultimate revenues of the individual patrons (who now sell *jointly*) are not inter-dependent.

Consider a marketing (or processing) cooperative which obtains for the amount V of its members' output a total revenue R, while incurring a total cost C in the open market, and a cost p_sS for the use of the members' capital. The ultimate revenue of the *i*th member, with a volume of patronage v_i and investment s_i can be written as

$$\text{VII} \qquad r_i = \frac{(R - C - p_sS)v_i}{V} + p_s s_i.$$

Assuming again S to remain constant while V varies, and writing MC for the change in C resulting from an incremental change in V, and MR for a corresponding change in R, a shift by the *i*th member from v_i to $v_i +$

[10] Evidently, if on the one hand c_i is always increasing when $(V\text{-}v_i)$ is falling for any given v_i, members' patronage is always complementary, and if on the other hand c_i continues to fall until $(V\text{-}v_i)$ vanishes, the individual member may be better off operating his own integrated plant.

ΔV, the patronage of other members being constant, results in a new total revenue for that member as follows:

$$\text{VIII}\quad r_i + \Delta r_i = \frac{[(R_v + MR_v) - (C_v + MC_v + p_s S)](v_i + \Delta V)}{V + \Delta V} + p_s s_i \,.$$

If we deduct identity VII from identity VIII, we have

$$\text{IX}\quad \Delta r_i = (MR_v - MC_v)\,\frac{v_i + \Delta V}{V + \Delta V} + (R_v - C_v - p_s S)\left(\frac{v_i + \Delta V}{V + \Delta V} - \frac{v_i}{V}\right)$$

which represents the net marginal revenue of the ith member resulting from a small increment in his deliveries to the cooperative plant. It shows that the ith member obtains only a portion of the marginal revenue, and bears only a portion of the marginal cost, that result at the cooperative plant from his adjustment, but that in addition his shares of both the initial total revenue and the initial total cost increase with the rise in his relative patronage. Hence Professor Phillips' relevant condition (2b) must be restated as

$$(2''\text{b})\qquad mc_{ik} = mr_{il},$$

where mr_{il} is the net revenue obtainable by the ith member when an additional amount of his output k is transformed into commodity l by the cooperative, and is equivalent to Δr_i in identity IX. Further, as the ith member changes his patronage of the cooperative by an increment, the total, as well as the marginal, revenue of the other members, maintaining their patronage momentarily constant, will either rise or fall. More specifically we can describe the effect of a shift from v_i to $(v_i + \Delta V)$ by the ith member upon the total revenue of the jth member, r_j, by the following expression:

$$\text{X}\quad \Delta r_{j(V|v_j)} = \frac{v_j}{V + \Delta V}\left[(MR_v - MC_v) - \frac{(R_v - C_v - p_s S)\Delta V}{V}\right].$$

Defining $(R_v - C_v - p_s S)$ as the total nominal residual revenue in the cooperative plant at level V, and its elasticity with respect to V, say ERR_v, as

$$ERR_v = \frac{(MR_v - MC_v)}{R_v - C_v - p_s S} : \frac{\Delta V}{V},$$

we can conclude from identity X that as the ith member changes his deliveries to the cooperative plant by an increment, the other members are "penalized" if $ERR_v < 1$, and "subsidized" if $ERR_v > 1$. The said elasticity will continuously decline if MC_v is rising while MR_v is constant, or else where MR_v is falling and MC_v is not falling faster. ERR_v vanishes where $MR_v = MC_v$, and consequently antagonism may develop among

members of a marketing cooperative association before marginal cost is equated to marginal revenue in the joint plant. When the expansion of individuals imposes a noticeable "penalty" upon the other members, pressure may develop among the patrons to regulate patronage (as well as entry) by a deliberate vote. As in the case of a procurement cooperative, we can visualize a process of negotiation whereby every member will gradually recede from an "ideal" target until a compromise is worked out than can obtain a majority approval. Again, the "ideal" state for the ith member can be ascertained first by selecting a level of V for each possible level of v_i that will raise the corresponding r_i to a maximum; then, considering the cost curve of producing the intermediate commodity at the plant of the ith member, the combination of v_i and V can be ascertained that will yield the ith member, as an independent operator, the highest possible profit, the next highest, and so forth. This array of combinations of v_i and V from the most to the least profitable can be visualized as the path along which the ith member will retreat as he seeks a compromise with the rest whereby patronage can be regulated. Unlike the case of a procurement cooperative, however, the technical feasibility of duplicating plants may not resolve the antagonism, which may result in a marketing cooperative association from a restricted market.

Now on the matter of a cooperative equilibrium, let us turn to condition (1) by Professor Phillips (see above), which is based on the premise that "the entrepreneurs of the associated firms each must allocate productive resources to their common plant, the same as a multi-plant firm must allocate resources to each of its plants" (*op. cit.*, p. 75). The condition, like the premise upon which it is based, begs some questions. For one thing, if we assume (as we have done with Professor Phillips throughout) that patronage of the cooperative plant by its members is exclusive, in the sense that the cooperative enterprise does not cater to non-members nor do members patronize competing enterprises, no procurement cooperative faces a revenue function independent of its costs (including payments to members' capital); and while a marketing cooperative does face such an independent function, there does not exist an independent revenue function for the plants which patronize it. Consequently, it is hard to conceive a comparison of the marginal value products of a resource between a cooperative plant and a plant which patronizes it. Under exclusive patronage, a cooperative association cannot be analogued with a multi-plant firm each plant of which being connected to the open market. At best it is suggestive of a vertically integrated company which neither sells intermediate outputs in the open market nor supplements intermediate outputs by purchase. Such a company can maximize its returns from limited resources which are usable at successive stages by diverting additional amounts, as long as they last, always to that particu-

lar stage of production at which their effect upon the ultimate revenue is greatest. It obviously requires that the input-output ratios at each stage be completely variable and that inputs within stages, including intermediate outputs, be substitutional. (Hence, at any non-preliminary stage, a limited resource is assumed a substitute for its own output at an antecedent stage.)

Consider, for instance, the simple case of a two-stage integration, where f_1 and f_2 are respectively the production functions at stage one and two, such that

$$f_1 = f_1(x_1, y), \quad \text{and} \quad f_2 = f_2(f_1, x_2, z),$$

x being a resource available in a limited amount usable in both stages, and y and z being specialized resources obtainable in the open market. Assuming the output at each stage to be of one kind, we can deduce that for any given combination of y and z, the limited resource, x, will be most profitably allocated between the two stages when the equality holds

$$\text{(1')} \qquad \frac{\partial f_2}{\partial x_2} = \frac{\partial f_2}{\partial f_1} \frac{\partial f_1}{\partial x_1},$$

provided that the marginal revenue from the sale of the finished output has not become negative. Similarly, if the output of the second stage is produced by m individual plants, so that

$$f_2 = \sum_{i=1}^{m} f_{2i},$$

the most efficient allocation of x for any given combination of y and z is defined by

$$\text{(1'a)} \qquad \frac{\partial f_{2i}}{\partial x_2} = \frac{\partial f_{2i}}{\partial f_1} \frac{\partial f_1}{\partial x_1} \text{ for every plant } i.$$

It means verbally that in every plant of the second stage, the marginal rate at which x substitutes for the intermediate output of the first stage is equated to the marginal rate at which x is transformed in the first stage into that intermediate output.

If, alternatively, the finished output is produced in one plant, while the intermediate output in n plants, so that

$$f_1 = \sum_{i=1}^{n} f_{1i},$$

x will be most profitably allocated between the two stages for a given combination of y and z when the equality holds

$$\text{(1'b)} \qquad \frac{\partial f_2}{\partial x_2} = \frac{\partial f_2}{\partial f_1} \frac{\partial f_{1i}}{\partial x_1}, \text{ for every plant.}$$

Verbally, it signifies an equality between the marginal rate of transformation of x into the intermediate output of the first stage in each plant, and the marginal rate at which x substitutes for that intermediate output in the second stage.

The last two structures superficially resemble cooperative "clusters," yet neither in a procurement cooperative (a "divergent" flow) nor in a marketing or processing cooperative (a "convergent" flow), are limited resources available to the individual members likely to be vertically allocated between the patrons' plants and the cooperative enterprise on the pattern of the foregoing equalities (even if f_2 is expressed as value-output rather than in physical terms). The reason, again, is the plurality of interests and its peculiar complications.

To simplify the theoretical argument, let us regard capital as the limited resource which each member has to allocate between the cooperative plant and his own plant. We shall thus assume limited or no borrowing by the cooperative venture from non-patrons, lest there be no genuine problem of resource allocation on the pattern of Professor Phillips' proposition. Further, a problem of resource allocation *between* stages will exist only if we assume for a procurement cooperative that its intermediate output can combine with capital in variable proportions to produce a finished commodity in the patrons' plants; and for a marketing or processing cooperative, that its finished output for sale can be produced from variable combinations of capital and the intermediate commodity furnished by the patrons' plants. Now, if an individual patron of a procurement cooperative were to confront the cooperative plant as a firm practising "closed" vertical integration, it should be possible for him, as equality (1′a) above requires, to increase his capital contribution to the cooperative, s_i, by an increment Δs, say, and obtain the consequential marginal output, ΔV, of the cooperative without any change in outlay. But as the costs of a procurement cooperative are borne by all the members in proportion to patronage, it is impossible for any individual patron to reallocate a resource (capital, for that matter) between his own plant and the cooperative without affecting his outlay c_i. The marginal outlay of the ith member resulting from the diversion of a small amount of capital from his own plant to the procurement cooperative, say $\Delta c_{i_{(s_i|C)}}$, can be measured from identity I as follows:

$$\text{XI} \qquad \Delta c_{i(s_i|C)} = (C + p_s S)\left(\frac{v_i + \Delta v_i}{V + \Delta V}\right) - p_s \Delta S\left(1 - \frac{v_i + \Delta v_i}{V + \Delta V}\right),$$

assuming that the ith member absorbs Δv_i of the incremental output of the cooperative plant that the additional capital had yielded, ΔV. Such an incremental shift will be profitable so long as the substitution of Δv_i for the capital increment in the patron's plant (producing commodity k for

sale) increases the total revenue from the sale of k in the ultimate market by more than $\Delta c_{i(s_i|C)}$.

Similar diversion of a small amount of capital from a patron's plant to a marketing cooperative does not necessarily yield the patron a return equal to the marginal value productivity of that capital in the cooperative plant (nor equal to the corresponding average value productivity), but, given a fixed level of p_s, an amount $\Delta r_{i(s_i|C,V)}$, say, for the ith patron, definable from identity IX as follows:

$$\text{XII} \qquad \Delta r_{i(s_i|C,V)} = MR_s \frac{v_i}{V} + p_s \Delta S \frac{V - v_i}{V},$$

where MR_s signifies the marginal value productivity of capital in the cooperative plant. Such incremental diversion of capital to a marketing cooperative is profitable only if

$$\Delta r_{i(s_i|C,V)}$$

in identity XII is greater than the change in r_i that would result from using the same capital increment to raise the output of the patron's plant and expand his patronage by a consequential increment v_i. It will thus appear, even without further elaboration, that if the participants in a cooperative association are given full freedom to individually allocate their resources between their respective plants and the cooperative to their best possible advantage, the pattern which will ultimately result will normally differ from that which can be expected under a single interest. No individual member of a cooperative will as a rule aspire to satisfy the equalities which have been formulated above for a firm which practices "closed" vertical integration.

As to the assumption that each patron can at will reallocate individual resources between his own plant and the cooperative, it will be noted that in practice the issue usually presents itself as one of each member's participation in the joint investment, and that such participation is generally regulated by some formula. At most, individual members can vary their capital contribution within given limits (such as where they can buy debentures from the cooperative in addition to their non-optional investment); otherwise they are required to invest in the cooperative equal amounts of money, amounts proportional to patronage, or amounts equal for one kind of obligatory investment and proportional for another. Obviously, whenever the investment of individual patrons is constitutionally regulated by a rigid formula, s_i ceases to be an independent variable in the ith member's profit function. It is mostly in its power to elucidate the economic consequences for individual participants of such investment regulations that analysis in more abstract terms, such as those of Professor Phillips' proposition, may prove useful.

A related economic datum which we have not yet examined, and which is theoretically bound to affect the economic choices of individual members of a cooperative association is the level of p_s, the rate of returns on patrons' capital used in the joint plant. Whether p_s is constitutionally pre-set or is subject to periodic revisions, it has some economic implications which are worth a brief tentative exploration.

Consider first a permanent cooperative as before, such that identity I can be re-written for its ith member as follows:

$$\text{XIII} \qquad c_i = \frac{Cv_i}{V} + p_s\left(\frac{Sv_i}{V} - s_i\right),$$

where the first expression after the equality sign depicts the share of the ith member in the total real outlay of the cooperative venture, and the next expression signifies the net balance of payments on members' capital pertaining to the ith patron. It is not hard to see from identity XIII that for any given distribution of the individual volumes of patronage v_i, relative to the individual capital contributions s_i, members for whom $v_i < Vs_i/S$ will benefit by a raise of p_s, while those for whom $v_i > Vs_i/S$ will lose; members whose patronage is proportional to their capital share, namely for whom $v_i = Vs_i/S$, will neither lose thereby nor gain. Hence a change in the level of p_s for any given distribution of the ratio s_i/v_i implies a shift of income from some members to others.

This can be shown from another angle. The net economic gain of an individual operator from participating in a procurement cooperative (with exclusive patronage in the specified sense) can be measured as the excess of the outlay he will have to incur in the open market in procuring an amount v_i of output l of his cooperative venture over his corresponding share of the nominal costs of the latter, c_i, minus the total returns which he can obtain in the open market for his investment s_i in the cooperative plant. Signifying this gain as g_i, we can write:

$$\text{XIV} \qquad g_i = p_l^0 v_i - c_i - p_s^0 s_i,$$

where p_l^0 is the market price of l and p_s^0 the rate of return on s_i obtainable in the open market. Substituting for c_i and dividing by v_i throughout, we obtain for the ith member the net economic gain from participation *per unit* of commodity l procured, say ag_i, as follows:[11]

$$\text{XV} \qquad ag_i = p_l^0 + (p_s - p_s^0)\frac{s_i}{v_i} - \frac{C + p_s S}{V},$$

for the specific levels of v_i and V.

[11] It may be of interest to note that in the ideal environment of perfect competition, where resource mobility, foresight, and resource divisibility are all unlimited, g_i for any i is likely to vanish. In other words, in such ideal environment there may be no *special* gain from cooperation.

As identity XV reveals, an incremental change in p_s, other things being equal, will result in an incremental change in ag_i, for any i, equal to

$$\left(\frac{s_i}{v_i} - \frac{S}{V}\right).$$

Successive increments in p_s will therefore continually reduce the unit-gain from participation, ag_i, for members whose patronage is large relative to their capital investment in the cooperative, in favour of members for whom

$$\frac{s_i}{v_i} > \frac{S}{V}\,.$$

If p_s rises high enough, the unit-gain from participation will completely vanish for the member with the smallest ratio s_i/v_i, then for the member with the next smallest ratio, and so forth. Identity XV also reveals that all the members will have an equal unit-gain from participation in the cooperative venture if p_s is chosen equal to the corresponding market rate, p_s^0.

From identities XIII and XV we can now infer that if the patrons of a cooperative plant are required to invest in their joint plant in proportion to patronage, they will all be indifferent to the magnitude of p_s and thus may theoretically set it at any level. (Note that their unit-gain from participation, as defined, will always be equal.) However, if the patrons are required by constitution to invest in their cooperative equal amounts of capital irrespective of patronage, the level of p_s may, under certain conditions, be subjected to economic pressures.

Consider, for instance, a hypothetical case of a procurement cooperative whose p_s is not constitutionally pre-set (though it need not be a residual return), whose members at all times strive individually to maximize their respective profits, and whose elasticity of total nominal costs, EC_v, is constantly not greater than unity. Assume initially that the derived demand on the part of the patrons for the intermediate output of the cooperative is highly inelastic but not uniform, so that all the v_i's are distributed in some rigid manner about the value $v_i = Vs_i/S$; hence, the distribution of v_i for all i can change only through the entry of new patrons and the exit of others. Now, if at a given moment, with a given p_s, the inequality $v_i < Vs_i/S$ holds for a majority of the members, they may successfully try to move a raise of p_s (granted equality of voting rights), and thus bring about a shift of income within the association. If additional raises ensue, a point may be reached where the gain from participation, g_i, of the member with the highest v_i is more than exhausted, then the corresponding gain of the member with the next highest v_i and so on, forcing them to retract from the joint venture. Initially the prospect of retraction need not necessarily, on economic grounds alone, deter a

majority of the members from carrying the motion, but as it is brought about, V will decline faster than S and the minority group will expand in numbers at the expense of the majority group. Furthermore, since EC_t has been assumed not larger than unity, every additional retraction of a large patron will have a depressing effect upon the gain from participation of *all* the remaining members. Consequently, the higher p_s is raised above some initial level, the stronger will the opposition grow to further increases, until a point is reached where no additional raise of p_s can obtain a majority approval.

With a less inelastic demand for the intermediate output of the cooperative plant, v_i cannot any more be regarded as rigidly distributed, and the situation becomes more complex. It can be seen from identity III above that a raise of p_s above some initial level will raise the marginal cost of procurement, Δc_i, for *all* the patrons, but that the effect of a given change in p_s will be greater upon the marginal procurement-cost of small patrons than upon that of large ones. So, under the specified assumptions, an incremental change in p_s will induce contraction of total patronage, V, and also a change in the distribution of v_i about its level of proportionality $v_i = Vs_i/S$, depending upon the exact augmentative effect of such a raise on all the Δc_i's, upon the respective elasticities of the derived demand for the cooperative's output, and upon the reciprocal effects of readjustment. (As can be seen from identity V, the contraction of other members' patronage under $EC_v < 1$ raises Δc_j for the jth member even if p_s is constant.) In short, if at all times the individual patrons gravitate towards their most profitable scales of operation, a raise of p_s will naturally initiate a search for a new equilibrium. Successive raises of p_s will meet, beyond a certain point, with increasing opposition, if not due to a decisive change in the distribution of v_i about its level of proportionality $v_i = Vs_i/S$, then due to the unfavourable impact of such raises upon the level of total patronage under $EC_v < 1$. Similar arguments can also apply to the reduction of p_s, if at some initial stage the inequality $v_i > Vs_i/S$ holds for a majority of the members.

A less determinable situation will be encountered when a procurement cooperative operates within a range of EC_v significantly larger than unity (due to a severe resource limitation, say). In this case, as has been already suggested, pressure may evolve to regulate patronage by deliberate action, so that both p_s and the distribution of v_i (including the regulation of entry) will have to be set from the start in a manner acceptable to a majority of the members. The complexity of negotiation where p_s is not constitiutionally pre-set can be easily imagined.

The basic economic considerations underlying the determination of p_s (or the under-currents generated by a pre-set level of p_s) in a procurement cooperative apply also to a marketing (or processing) cooperative. For the latter, identity VII can be written as:

$$\text{XVI} \qquad r_i = \frac{(R - C)v_i}{V} + p_s\left(s_i - \frac{Sv_i}{V}\right),$$

implying that a raise of p_s above an initial level, other things being equal, will benefit members with small patronage relative to their investment at the expense of members with large patronage. Further, writing $p_k{}^0$ for the price that the ith member can obtain in the open market selling a volume v_i of his semi-finished output k, his unit gain from patronizing a marketing cooperative can be measured as:

$$\text{XVII} \qquad ag_i = \frac{R - (C + p_sS)}{V} + (p_s - p_s{}^0)\,\frac{s_i}{v_i} - p_k{}^0,$$

for the given v_i and V, which can be easily compared with identity XV above.

In essence, the setting of p_s at a specific level in a marketing (or processing) cooperative concerns the division of the total real residual revenue of the joint venture, (R-C), between two factors of production, i.e. the semi-finished commodity supplied by the patrons and their capital contributions, in a manner that will be acceptable to a majority of the patrons. As we have already seen in connection with procurement cooperatives, there is no specific level at which p_s will be universally set if left solely to the interplay of economic interests within the cooperative associations.

Having thus examined some of the issues that a cooperative equilibrium involves, it will appear that much exploration must still be done before a complete economic theory of cooperation becomes available.

The "Economic Life" of a Cooperative Enterprise

The foregoing observations about the plurality of interests in a cooperative association and its economic equilibrium bear upon the question as to where the entrepreneurial role resides. The notion that "a cooperative has no economic life" of its own, or "has no entrepreneurial unit; its member units each have their entrepreneur",[12] has already been contested, plausibly it seems, by Dr. Savage.[13] But the latter's remark that there is a need for a "broader interpretation of the definition of a firm in accord with actualities" (*ibid.*, p. 532) suggests the possibility that the controversy verges on a verbal disagreement.

Legal considerations apart, the conception of the firm in economics as a profit-maximizing entity appears rather useful, and, for all its oversimplification, not unrealistic. Those enterprises which have no profit motive of their own, nor are subjugated to the self-centered interest of a "central office," operate as "utilities" in the service of several profit-maxi-

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[12] Professor Phillips, *op. cit.*, p. 76.

[13] *Op. cit.*, p. 531.

mizing entities simultaneously, and for this reason do not require that the basic premise of profit-maximization be replaced. Rather, the core of the difficulty appears to reside in the varied connotations given the word "entrepreneurship" in different economic contexts.

First, there prevails in economics the original concept of the "entrepreneur" as an individual who combines acquired inputs in anticipation of profit, and who thus functions as a "manager, owner, risker." Although in modern times management largely has become separated from ownership and risk-bearing, many economists still find the original concept useful.[14] Secondly, there prevails the Schumpeterian concept, which had its roots in a distinction, as old as "the time of the younger Mill," between the "capitalist" on the one hand (i.e. "the possessor of produced means of production"), and the initiator on the other.[15] According to this concept, pertaining to the theory of economic development, the entrepreneur is the innovator who carries out new combinations of existing factors of production and brings about discontinuous economic changes. He is not necessarily a risk-bearer, and so can be "a dependent employee" (*ibid.*, p. 75), motivated by the "joy of creation" and other non-monetary motives (*ibid.*, p. 93), yet he is distinct from the "mere manager," who is engaged in supervising repetitive operations in a well-tried, predictable environment. Lastly, there is the concept of the entrepreneur as the supreme manager of the firm, who coordinates the delegated functions of all the subordinate managers, and who represents by definition a non-multipliable factor of production.[16] This concept, which seems to have evolved primarily as a methodological necessity to explain the presupposed incidence of decreasing returns to scale in the context of the theory of the firm,[17] resembles the Schumpeterian concept in that it does not identify entrepreneurship with the role of risk bearing, but it is not as specific and illuminating. If we were to try and identify the role of "top coordination" with a particular status in the hierarchy of a firm which is run by a hired management (a problem of little relevance to the issue of returns to scale), we would probably find it problematic to choose between the group of owners holding the majority vote on the one hand, and the hired management, itself performing a delegated function, on the other. While no clear-cut choice can be made here in reality, we shall find it useful to discern, for such firms, between the ultimate authority to make major decisions, resting in

[14] See, for instance, the relevant comments by P. Sargant Florence in *The Logic of British and American Industry*, London, 1953, p. 299.

[15] J. S. Schumpeter, *Theory of Economic Development*, Harvard, 1934, p. 77. The original German edition was published in 1911.

[16] See, for instance, the related comments by T. Scitovsky in *Welfare and Competition*, Chicago, 1951, pp. 190-93.

[17] N. Kaldor, "The Equilibrium of the Firm," *The Economic Journal*, Vol. XLIV (1934).

the owners' majority of votes, and the locus where most major decisions are actually generated and often made, namely the hired professional management. If, then, one associates "entrepreneurship" and "economic life" with the ultimate authority to make business decisions, related to a self-centered pursuit of profits, a cooperative enterprise has none. In this respect it can be likened to a branch or a department of an independent firm. But if one associates these terms with the actual locus where major decisions are generated, and often made, a cooperative enterprise can certainly be viewed as a "going concern" (as Dr. Savage has argued), having its own "entrepreneurial unit."

The degree of independent enterprise shown by the hired management of a cooperative venture will often vary with the economic circumstances. Where, for instance, the industry in which the patrons operate is atomistic, there may be a great disproportion between the scale of operation of the cooperative plant and that of the individual members. The tasks facing the management of the cooperative venture, both, say, in combating monopoly and in implementing innovations, may call for strategies and technical judgment far beyond the experience and possibly the competence of most members. Where such is the case, the members of the cooperative must exercise their authority mainly by critically following the policies of their professional management, rather than by giving it directions. Partly as a result of such situations not only do we hear complaints about the passive attitude of the members of cooperative associations, but in fact witness cooperative enterprises expand much beyond the scope originally set for them by their founders, or perform tasks that could not have been foreseen in the light of the original needs. A more independent task still may be assumed by a cooperative management where the interests of the individual members become acutely conflictory, due to sharply rising unit-costs, saturation of a market, decline in their numbers, or other reasons. There, the hired management of the cooperative venture may have to devise workable compromises and possibly act as a neutral guardian of everybody's interest as he patronizes the joint plant.

It seems that both the former task of business-leadership and the latter task of accommodation are more characteristic of the "central office" of a multi-plant company than of the individual managements of its constituent enterprises. They are apparently even more characteristic of the management of public utilities and other collective ventures.

THE FARM: THE MISUSED INCOME EXPANSION BASE OF EMERGING NATIONS

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FOR many thousands of years the productivity of labor and the technical procedures used in agriculture remained unchanged. Agriculture in 1200 A.D. Europe was little different from agriculture in 500 B.C. Egypt or 1500 A.D. Inca Peru or, for that matter, 1961 Viet-Nam.[1] Finally, in America and Western Europe of the late 19th century, the ancient methods of producing food and also the institutional organization began to move step by step toward industrial agriculture as it is known today in these sections of the world. The productivity of manpower used in agriculture in the United States[2] caught up with the level in industry largely as a result of the extensive experimental and applied work carried out under the great stimulation of our colleges of agriculture.

This very fundamental but largely a 20th centrury aspect of the industrial revolution is of utmost importance to the low-per-capita-income countries of the world. Their failure to emphasize it in development programs is explained by many historical, behavioral, and general political and economic considerations. This paper will very briefly point out and analyze these factors while developing an approach for introducing modern industrial agriculture into these economies.

As much as 60 to 70, maybe 80 per cent of the people of the emerging nations continue to scratch out a living practicing agriculture as it was practiced in 18th century Europe. These people and their very low productivity form the obvious crux of a development program. The average person of these nations cannot enjoy the minimum requisites of decent food and shelter plus education, some enjoyment of the arts, and a gradual expansion of machine use in his daily life unless productivity of the major industry is expanded.

Why Agriculture Remained Handicraft

Venkatasubbiah, in an ambitious study, *Indian Economy since Independence,* fails to include any careful discussion of land use or the agri-

[1] Henri Pierenne, *Economic and Social History of Medieval Europe* (London: Routledge J. Kegan, 1936), pp. 58-86. Sally Falk Moore, *Power and Property in Inca Peru* (New York: Columbia University Press, 1958), p. 19. Price Gittinger, "Agrarian Reform," *Viet-Nam—The First Five Years* (R. W. Lindholm, ed.), (East Lansing: Mich. State Univ. Press, 1959), pp. 200-12.

[2] Henry Underwood Faulkner, *American Economic History,* 4th ed. (New York: Harper & Bros., 1938), pp. 447-76.

cultural industry.[3] This neglect cannot, of course, be explained by the unimportance of agriculture as a contributor of GNP or by the small number of people engaged in the activity or by the lack of seriousness of the problems. It can only be explained in terms of Mr. Venkatasubbiah's belief that agriculture is not really an industry but a way of life. If agriculture is a way of life and not an industry, nothing could be more natural than to exclude it when considering strides taken and to be taken in improving the balance of international trade, and to deal with it only when talking of village life and folk ways generally.[4]

It seems to be well established in the free world group of emerging nations that modernization of the new evolving societies requires modern steel mills and even wells in the country to provide relatively pure water. It also seems to be accepted that commercial fertilizer plants are required, but the development of a highly productive, surplus-producing agriculture seems not to be necessary.[5]

It is not possible to trace the sources of this position with the exactness that one desires. However, some of the elements which seem to go into making it up can be briefly considered within the context of this discussion.

(1) The new agricultural experts of these emerging nations have been influenced mightily by American professors of agriculture. Many of these professors have been imbued with the idea of the family farm in the United States. And even though they saw the family farm in India, let us say, to be quite different from its United States counterpart, they still advocated it because it seemed to be the answer to communist propaganda of land for the landless.[6]

Therefore, the tremendous prestige of American agriculture was thrown on the side of some rather vague concept of the good old days memorialized in the ballads of all peoples, when every man was his own boss and lived a fabled life on his acreage.

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[3] H. Venkatasubbiah, *Indian Economy since Independence* (New York: Institute of Pacific Relations, 1959).

[4] Oscar Lewis, *Village Life in Northern India* (Urbana: Univ. of Ill. Press, 1958), pp. 31-111; John E. de Young, *Village Life in Modern Thailand* (Berkeley, Univ. of Calif. Press, 1955), pp. 76-146.

[5] This is, for example, a good description of the situation in Korea. (Mimeographed studies of University of Oregon economic development advisory group to the Economic Development Council of Korea.)

[6] The situation in many of the emerging nations has been similar to that described by Lucy E. Textor as existing in Czechoslovakia after World War I: "Before the matter (land reform) could be studied from all points of view, the land-hungry people forced the issue. The temper of the time was such that provision for the expropriation of the giant estates had to be made without delay. This must never be forgotten in passing judgment upon the law of April 16, 1919." Lucy E. Textor, *Land Reform in Czechoslovakia* (London: George Allen & Unwin, 1923), p. 140.

(2) Observers from the evolving countries saw that agriculture remained primitive (non-mechanized) in areas highly developed in manufacturing and transportation; e.g., pre-World War II France and Germany. Therefore, it seemed to be normal for a development program to be partial, with the people on the land living and working largely as they had during the past thousand years or so while goods were transported with the aid of giant diesels and assembly lines typified fabrication. As a result, they recommended to their governments that programs along this line were suitable.

(3) The large number of persons absorbed in agriculture when continued along traditional lines seems to be a practical barrier to any significant new approach. The question—What would happen to all of the people now on the land if modern American agriculture were introduced?—has been too big or too nebulous a question for planners to face up to.[7]

The land use policy of the emerging nations in 1961 is the result of the above combination of circumstances, and it has seldom been openly discussed in terms of development goals and production efficiency.[8] Yet the record is abundantly clear that Japan's resurgence in the post-war period was fundamentally related to the reduction of the percentage of the Japanese labor in agriculture from 49.9 per cent in 1947 to 37.9 per cent in 1955.[9] Also, the original chucking aside of feudalism by Japan was agriculture propelled, and it is often forgotten that even Puerto Rico's rapid income expansion is agriculture rooted.[10]

Two fundamental errors run through the entire gamut of current agricultural policy in the emerging nations within the United States orbit. First, a failure to establish programs that reflect the depth of the revolt

[7] For example, ". . . The Mysore Land Revenue Revision Committee came to the conclusion that all schemes dealing with the evil of subdivision foundered on the rock of inheritance and, therefore, suggested that until there was redistribution of population from agriculture to industry, it would not be opportune to interfere with the laws of inheritance." Govindal D. Patel, *The Indian Land Problem and Legislation* (Bombay: N. M. Tripathi, 1954), p. 250.

[8] William Bredo in "Rural Industrialization for Agricultural Development," *J. Farm Econ.*, 41:1332-44 (Dec. 1959) skirts the edge of the problem but his main concern is with decentralization of industry. He does, however, emphasize the importance of mechanized agriculture to economic development and fully recognizes it to be a slow process.

[9] H. Ouchi, *et al.*, *Nihon Keizai Tokei Shu* (Collections of Japanese Economic Statistics), (Tokyo: Nihon Hyoron, 1958).

[10] Reuben E. Slesinger, a bit unrealistically, perhaps, states in regard to Puerto Rico, "It typifies the usual course of development: improved agricultural practices, mechanization of agriculture, need for fewer workers on the farms, rising unemployment, migration to the cities, industrialization in the cities, reduced birth rates." "Some Comments on Nonagricultural Possibilities for Raising the Levels of Living of Underdeveloped Nations," *Amer. Econ. Rev.*, May 1956, p. 335.

that is taking place among the people of these nations;[11] second, a failure to fully utilize America's leadership in agriculture.

Typically, technical development programs have established practices to improve conditions somewhat, but largely keep the old procedures and old institutional relationships untouched. Sometimes the programs have obviously been aimed only at countering some move or pledge made by the Communists. Neither of these types of approaches is adequate.[12]

When agriculture is carried out largely as a method by which people earning their subsistence from the land produce their own food and fiber plus thermal units needed for heating and cooking, the production parameters are very different from those existing under modern conditions.[13] Subsistence agriculture does not fit the requirements for efficient production of the products utilizing land as a production base.

If it is true that traditional agriculture cannot meet price competition of commercial agriculture and that commercial agriculture does not naturally evolve from traditional peasant agriculture, then a very large portion of our agricultural policy advice and agricultural assistance dispensed to underdeveloped areas has been wrong.[14] It is also true that much of our technical assistance in agriculture which has been aimed at providing small peasant ownership plots and improved techniques for operating these plots will not do the job.

The failure to sufficiently emphasize agriculture as a major industry

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[11] "They are in revolt not merely against the West, but against their own past. . . ." Christopher Dawson, *The Movement of World Revolution* (New York: Sheed & Ward, 1959), p. 103.

[12] That India has been going down the wrong road in agriculture is now widely realized—in Indian economic development circles. "The urgent task of the 1960's will be to underpin the Five Year Plans with effective policies of agricultural production and distribution. What has been achieved for such commercial crops as jute shows that it can be done." Geoffrey Tyson, "India Plans for the Sixties," *Lloyds Bank Review*, April 1960, p. 17.

[13] Vernon W. Ruttan, "Research on the Economics of Technological Change in American Agriculture," *J. Farm Econ.*, 42:743 (Nov. 1960).

[14] The Food and Agriculture Organization of the United Nations in its *The State of Food and Agriculture 1958*, in Table 11-6, p. 21, summarizes net exports by volume of *all* agricultural products on the basis of an index with 1951-53 = 100. For the Far East (excluding China) the index was 179 in 1955, 55 in 1956, and 17 in 1957. For Latin America the general situation was better, the index average for 1934-38 was 114 and in 1957 it was 110.

In the same report in page 18 it is reported that "a poor crop in India (1957), coincided with an increased demand, made it necessary to restrict movements of grains, resume procurement, and increase imports. In Pakistan food shortages were reported in some areas." And on page 19, "Exports of agricultural products from Latin America declined, . . ."

The basic agricultural industries of the emerging countries have been declining rather than expanding as would be necessary if they were to provide the surpluses required for industrialization.

encountering worldwide competitive conditions and going through a technological development of considerable scope must be set down as a major weakness of much economic planning being developed in the emerging nations.[15]

Obviously, what is required is a policy that is a revolution in the deepest sense, but one which will not destroy the stability which must be maintained if democratic-capitalistic progress is to be made. A program of this sort within the area of activity under discussion here would permit modern agriculture to be introduced as practiced in the United States and Great Britain at a rate as rapid as the human and technical resources could be developed.

Industrialization Priorities

The basic economic relationship of a program to use agriculture as the core of a development program can be understood by persons with only a nodding acquaintance with the science of economics. The relationship is: If more food or as much food can be produced with fewer direct laborers, more persons can be supported and are available to carry forward activities only indirectly related to food production as well as activities completely unrelated to food production.[16] This is the fundamental relationship underlying economic development of most of the emerging nations. Or, put somewhat differently, a developed country has a larger portion of its people employed as schoolteachers, technicians, dentists, food packagers, assembly line workers, and concert pianists, because a smaller portion of the people is needed to raise the food required to meet consumption needs.[17]

With this basic proposition stated, the first job of economic planning for development seems obvious. It is (1) to maintain and increase agricul-

[15] The general attitude existing in many emerging nations toward the landlord and how he is distinguished from the large owner in industries other than agriculture is well stated in the following section from *The Pakistan First Five Year Plan 1955-60* (National Planning Board of Pakistan: Dec. 1957), p. 318, par. 54:

> We consider that the ownership of land is clearly distinguished from other forms of wealth. Landowners who do not manage and cultivate the land themselves, with very few exceptions, do little to increase its productivity. By contrast, the owners of most other forms of wealth are usually progressive and provide increasing employment by their activities.

[16] Family budget studies show that as much as 80 per cent of incomes is used to purchase food. Even in the high-income groups in a country as developed as Russia, the family food budget comprises about "43 per cent" of net income left after taxes. David Granick, *The Red Executive* (New York: Doubleday & Co., 1960), p. 116.

[17] "So low is the productivity of Latin American farm workers . . . that it takes three and a half persons working on farms to produce what is contributed to the national wealth by one person engaged in other activities." U. N. Commission for Latin America, *New York Times*, May 19, 1959. Trained observers of the Asian scene have frequently estimated that the marginal productivity of agricultural workers is near zero.

tural production while reducing the number of persons engaged in agriculture and (2) to develop ways to use the persons no longer required directly in food production.

Planners have typically backed into this fundamental aspect of increasing per capita productivity. They back in by first making provision for the establishment of certain industries that are to provide employment outside of agriculture. The first attack is made in this backward direction because goods these industries would produce are not being produced in quantity in the country and because there seems to be an abundance of unemployed and partially unemployed persons to man the new firms. Also, it is politically easier to develop manufacturing industries first because this has also become the accepted folklore of the way economic development takes place.[18]

The implementation of this procedure has certainly been only a partial success. A major shortcoming in both communist and non-communist areas has been that the agricultural sector has not been able to provide the food surpluses required to meet the needs of the expanded urban industrial and technical population.[19]

This shortcoming, although important, is not by any means the only problem which has arisen to plague this approach. Other difficulties in non-communist areas have included (1) finding markets for goods produced, (2) locating technical and managerial skills required, (3) preventing debasement of the currency, and (4) avoiding rural-urban conflict. These difficulties are sufficiently serious to justify a careful search for another approach.

If instead of starting with urban industrial growth, one started with rural modernization, the development plan would be based on a much different land-use program and would have a very different over-all impact. The typical procedure being followed today in the emerging nations largely considers agricultural land use as on the fringe of the new developments. The procedure considered below follows the simple logic that agriculture is the principal industry of the emerging nations, and it is an industry where labor productivity using modern techniques has expanded very much. Therefore, agriculture is the prime area to be attacked in raising productivity.

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[18] P. T. Bauer, *United States Aid and Indian Economic Development* (Washington, D.C.: Amer. Enterprise Assoc., 1959), pp. 24-56.

[19] "The Conference considered that careful studies were needed in the whole field of productivity and on agrarian reform in relation to productivity. . . . Particular emphasis was laid on the importance of comparative studies on the methods of consolidation of fragmented holdings." Food and Agriculture Organization of the United Nations, *Report of the Ninth Session of the Conference* (Rome: FAO, 1958), p. 42, par. 91.

A Development Program

Japan's economic development experience must be carefully considered when economic programs are being recommended for today's emerging nations.[20] Japan definitely used agriculture as the keystone of its program.[21] The way agriculture was used was determined by the technology available seventy or ninety years ago and by the cultural, economic, and political conditions of that period.[22]

Current government planning to accelerate development through treating agriculture as an industry and using its expanded per capita production to support people engaged in the variety of activities carried on in developing countries might follow a plan along the following lines.

1. Provide arrangements to initiate a crash program aimed at educating those who wished to learn modern agricultural methods. This would include instruction on how to operate and repair agricultural machinery. This program would be open to everyone, but the standards of accomplishment to be met to permit a participant to continue the program would be very high. Students would be paid a substantial salary while carrying on the program.[23]

2. The state would initiate a program of buying up land areas and forming farms of a size sufficient for sound commercial agriculture. These farms would be sold to the graduates of the above program, and the land purchased would be no greater than the amount needed to meet this requirement. The sale contract would provide for annual payments. Machinery would be financed through rental arrangements worked out with the farm machinery companies. Originally, this activity would be limited to a particular region.

3. The taxes levied on land included in these commercial farms would

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[20] The arguments of this paper badly need support, for such great academic names in economic development literature as Galbraith, Rostow, and Schultz have argued otherwise. J. K. Galbraith, "Conditions for Economic Change in Underdeveloped Countries," *J. Farm Econ.*, 33:689-96, Nov. 1951, Part II; W. W. Rostow, "The Take-off into Self-sustained Economic Growth," *The Economic Journal*, March 1956, pp. 25-48; Theodore Schultz, *The Economic Organization of Agriculture* (New York: McGraw-Hill, 1953), pp. 146-51. Professor Douglas C. North, "Agriculture in Regional Economic Growth," *J. Farm Econ.*, 41:943-51, Dec. 1959, forcefully supports a position akin to the one I have developed.

[21] This is brought out again and again by Thomas C. Smith in his *The Agrarian Origins of Modern Japan* (Stanford: Stanford Univ. Press, 1959).

[22] "Changes in farming had created a 'surplus': but the traditional features of agrarian society made it possible for the government to continue to take the surplus over many generations." *Ibid.*, p. 211.

[23] Mr. Patel, in the preface to his book, *The Indian Land Problem and Legislation (op. cit.)* writes: "In the present context of our underdeveloped economy what is most important is not so much who owns land as how land is cultivated. . . . It is no use entrusting cultivation of land to individuals who have neither the ability nor the experience to undertake it." Mr. Patel's solution is cooperative farming.

be based on capitalized value of the farm if modern commercial farming procedures were used. The assessed value of all other agricultural land would be gradually increased to this level.

It is also quite possible that higher land taxes will cause the ordinary renter and landowner to increase the efficiency of their operations so that they might enjoy the same income after the higher taxation as they had enjoyed before.[24]

If the imposition of land taxes will create pressures leading to a more rapid abandonment of traditional practices and adoption of more productive practices, it becomes desirable policy on this count alone. If, in addition, the collection of the taxes provides finances to make possible useful collective action, the increase of land taxes is doubly attractive.[25]

High taxes based on the productivity capabilities of modern agricultural land-utilizing techniques is a feasible program and is in fact in many ways the tax most compatible with the conditions encountered in emerging nations.[26] Closely correlating these tax collections with expenditure programs aimed at improving the productivity of the peasants taken out of agriculture should provide a political base that would when correctly used be capable of effectively combating pressures for the hopeless programs of land reform and family plots.

Agriculture was basic to Japanese development because the government was able to collect substantial agricultural property taxes.[27] In Turkey the government has in a general way followed a program of in-

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[24] Sir Stamford Raffles in 1813, when recommending a land reform system providing for the payment of cash rents by the cultivators of Java, said that his land reform would produce "industry, knowledge, and happiness." John Bastin, *Raffles' Ideas on the Land Rent System in Java* (S. Gravenhage-Martinus Nijhoff, 1954), p. 155.

Bauer and Yamey in 1957 write "Moreover, the compulsory reduction of rents may even reduce output, especially in the short run; this would occur if tenants prefer to take out the windfall gain partly or wholly in the form of more leisure." Peter T. Bauer and Basil S. Yamey, *The Economics of Underdeveloped Countries* (Chicago: Univ. of Chicago Press, 1957), p. 212.

Raffles was talking about the substitution of a free labor and market system for a slave-feudal system. Bauer and Yamey are analyzing the impact of reducing property rights through reduction of rents. Both are also providing support for higher land value taxation as an inducement to greater agricultural productivity.

[25] Neo-classical writers had this difference in use of tax-collected funds in mind when they talked of the distinction "between onerous and beneficial rates, the latter being those which were spent in providing services from which rate-payers benefited." Ralph Turvey, *The Economics of Real Property* (London: George Allen & Unwin, 1957), p. 67.

[26] This seems to be the general conclusion of Haskell P. Wald in *Taxation of Agricultural Land in Underdeveloped Economies* (Cambridge: Harvard Univ. Press, 1959).

[27] The land tax of Japan from 1868 to 1881 accounted for 78 per cent of ordinary revenues. These revenues provided the bulk of the savings which the government funneled into investment used to carry forward an industrial program. Thomas C. Smith, *op. cit.*, p. 211.

dustrial agriculture and the results of mechanization in expanded production have been substantial.[28] The impact, however, has been considerably blunted by the government's inability to collect agricultural taxes.[29]

The impact on labor productivity arising directly from the use of modern techniques and the reduction of the quantity of agricultural labor can be estimated by using some Japanese data. In 1951 the marginal productivity of labor in agriculture in Japan was $217 and in the United States, $2,691. The marginal productivity of one *hectare* of land in Japan in 1951 was $193 and in the United State, $28. Despite this high productivity of land in Japan and a hard-working farm population, the agricultural industry of Japan in 1951 made less effective use of its factors of production than the agricultural industry of the United States. About 25 per cent of the total difference in real output of agriculture in Japan and the United States is accounted for by "greater land availability in the United States" and about 75 per cent by such influences as "advantages of capital, technology scale, and so on."[30]

4. Persons relieved from performing agricultural activities because their land has been purchased by the government to be sold to the graduates of the agricultural specialists school would be placed on government payrolls if they so desired.[31] These payrolls would be largely met from the added tax receipts arising from the land now operated on a business basis.[32] The government would use these new employees to construct farm-to-city roads, sewers, and other projects and would provide them with evening adult technical training courses and day liberal and technical courses for the children. The increased productivity originating in better land use would spread through the society as the benefits of a generally more efficient use of manpower made itself felt.[33]

[28] William H. Nicholls, "Investment in Agriculture in Underdeveloped Countries," *Amer. Econ. Rev.*, May 1955, p. 64.

[29] *Ibid*, p. 66.

[30] Toyoki Okabayashi, *Measuring the Contributions of Natural Resources to the National Outputs of the United States and Japan* (Univ. of Oregon, unpub. Ph.D. thesis, 1960) p. 100.

[31] A program to carry on agriculture as a modern industry would go far toward the general upgrading of agriculture as a work career. A recent Philippines study shows ". . . and that only four per cent mentioned farming as their occupation preference for their children—although the Philippines is primarily an agricultural country." Edward Tiryakian, "Occupational Satisfaction and Aspirations in an Underdeveloped Country: The Philippines," *Economic Development and Cultural Change,* Vol. 7, No. 4, July 1959, p. 437.

[32] "We [the United States] have been producing in recent years on 20 to 25 million acres about the same amount of cotton as we were producing on more than 40 million acres in the period around 1930." Murray R. Benedict, *Can We Solve the Farm Problem?* (New York: The Twentieth Century Fund, 1955), p. 52.

[33] New technical developments are rapidly changing agriculture in Japan. "The Japanese government is drawing up legislation to encourage groupings of farmers into 'corporations,' which would purchase tractors and other machines that could

5. In the industrial sector, priority would be given to the development of plants producing farm machinery. In the distribution and marketing sectors, priority would be given to those aspects most directly related to agriculture; i.e., agri-business type development.[34]

Emphasis would have to be placed on growing certain agricultural products possessing a favorable international market. Careful planning here can produce "luck" such as Japan enjoyed during her early development period. Raw silk gave Japan an agricultural product suited to natural and other conditions existing in the country and also a product that could be sold to earn the foreign exchange needed to finance purchase of machines from foreign countries.[35] These exports, added to agricultural tax collections, provided the industrial investment base and support for all the ancillary activities fundamental to her industrial society.

This is a development plan moving gradually from the country to the city. The basic aim of the program is to make better use of manpower and to treat agricultural land as an industrial resource. As it becomes trained, the manpower released from agriculture will become available to teach in the schools and to play in the orchestras; in other words, the people will enjoy the benefits of economic development.

Conclusion

The basic assumptions of the industrial agriculture development program outlined here are (1) more food can be produced by the use of modern agricultural methods with only a fraction of the current manpower located on the farms; (2) people living off the farms and carrying out other pursuits do not require any greater quantities of food to meet their requirements than to people on the farms; (3) therefore, if fewer people are needed in agriculture, more people can be fed while carrying on non-agricultural and agricultural-related activities. The logic of emphasizing the development of the agricultural industry as the first major step or perhaps the basic platform for an economic development revolution has always seemed by non-professional observers to be the correct procedure, but, for reasons mentioned above, it has not been followed.

The alternative to a development program based on industrial agricul-

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be used by all members in turn. About 300 such corporations have already been formed." *New York Times*, Jan. 3, 1960, p. 3.

[34] John H. Davis and Ray A. Goldberg, *A Concept of Agribusiness* (Boston: Harvard Grad. School of Business Admin., 1957).

[35] The European production of silk was seriously reduced owing to the outbreak of the pebrine plague, while the demand for silk continued high. D. T. Lakdawala, *International Aspects of Indian Economic Development* (London: Oxford Univ. Press, 1951), p. 11, quoted in Albert O. Hirshman, *The Strategy of Economic Development* (New Haven: Yale Univ. Press, 1958), p. 172.

ture is one based on industrialization of fabrication. The industrialization of fabrication before the industrial agriculture base is developed looks a great deal like building the roof of a building before the foundation and the sidewalls have been completed. Here the foundation is comparable to efficient food production, which provides such a large portion of the immediate consumption requirements of the subsistence societies under consideration. The sidewalls are comparable to all the social and educational adjustments and understandings required of a population when it moves into the modern age.

It is possible to build the roof first, but if this is done, a great deal of effort must be expended to brace and support the roof while the foundation and the sidewalls are under construction. Also, by building all these supports for the roof, much manpower and materials are used which could have been used to build the sidewalls and the foundation if the roof were constructed at a later date.

AGE COMPONENTS OF DECREASE IN NUMBER OF FARMERS, NORTH CENTRAL STATES, 1890-1954[1]

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THIS article attempts to analyze the relationship between the decrease in total number of farmers and the replacement of an older generation of farmers by a younger generation. Even when the total number of farms remains the same, the occupants change as some older farmers retire or die and their place is taken by younger people. A decrease in the total number of farmers can only result from a modification in the process of retirement and replacement: either an increase in the number of farmers leaving farming, or a decrease in the number of people entering farming, or both.

A number of interrelations exist between the population dynamics of migration, retirement, death and replacement, and between the economic adjustments of mobility of labor and increases in size of farms. Death and retirement make land available for enlargement of existing farm units as well as for the entry of young people into farming. Increase in nonagricultural incomes and employment increases occupational change of farm operators and encourages young farm people to choose nonagricultural occupations. Increased competition for farms forces some operators out of farming and denies to some young people an opportunity to start farming. Thus different age groups of farm people are faced with somewhat different problems of adjusting to economic change. We can get some additional information about these adjustments by studying changes in the number of farmers within age groups, rather than by measuring only the change in the total number of farmers.

The following hypothetical example illustrates those components of change in the number of farmers which can be obtained by the analytical techniques used in this article. Suppose that in a certain area there are 1,000 farms, and that if the total number of farms is not changing, then, in a ten-year period 250 farmers would quit farming, retire, or die, and the same number of young people would enter farming. The terms "normal"

[1] Published with the approval of the Director as paper number 1108, Journal series, Nebraska Agricultural Experiment Station. The research reported in this article was done under Nebraska Agricultural Experiment Station Project 487 as a contribution to regional research of the NC-15 committee (North Central Regional Committee for Research on How Young Families Get Established in Farming). Special thanks are due to my colleagues on the regional committee, to Grove Lane, who did some of the initial analysis in his M.A. thesis at the University of Nebraska (1958), and to Sharon Hocker for much of the computational work.

A few of the results published in this article were used in a publication of the NC-15 committee: Don Kanel, *Opportunities for Beginning Farmers, Why Are They Limited?* N. C. Reg. Publ. 102 and Nebr. Agr. Expt. Sta. Bul. 452, 1960.

withdrawals and "normal" replacements will be used to designate the number of people leaving and entering farming under these conditions. However, if the same area is subject to farm enlargements which would eliminate 100 farms in the course of ten years, then the number of farmers leaving farming would have to exceed the number of people entering farming by 100. But changes in each of the above groups might contribute in varying proportions to change in the total number of farmers. The disappearance of 100 farms might result in a large increase in numbers of farmers leaving farming; for example, 320 farmers might leave (70 in excess of "normal" withdrawals), and 220 might enter (30 short of "normal" replacements). Alternatively, the major effect of a disappearance of 100 farms might be on the opportunities for beginning farmers; for example, 280 farmers might leave farming (30 in excess of "normal" withdrawals), and 180 might enter (70 short of "normal" replacements).

The illustration introduces two sets of components of change in the number of farmers. Actual withdrawal and entry make up one set. For example, the disappearance of 100 farms is the net difference of the withdrawal of 320 farmers and entry of 220 young people into farming. Further, if it is possible to estimate the number of "normal" withdrawals and replacements, then the difference between actual and "normal" withdrawals can be used as a measure of the number of farms which disappeared because of increased withdrawal, and the difference between "normal" replacements and actual entry would be a measure of the disappearance of farms due to decrease in opportunities for beginning farmers.

The discussion below will show how census information about the age distribution of farm operators can be used to build up some of the components of change suggested above. The census information used is for changes in the number of farms in the 13 states of the North Central Region: Kentucky, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North and South Dakota, Nebraska, and Kansas.

Farmers Belonging to a Cohort.

The methods used can best be illustrated by explaining the arrangement of data in Table 1. For any single census, information in a column shows numbers of farmers by age groups: under 25, 25-34, 35-44, 45-54, 55-64, and 65 and over. The data for any one row shows numbers of farmers in the same age groups as above but for successive periods. Thus for the row labeled the 1900 cohort, the first entry gives the number of farmers under 25 years of age in 1900, the second the number in the age group 25-34 in 1910, and so on until the sixth shows the number in the age group 65 and over in 1950.

Consider an individual farmer, born in 1877, who started farming at the age of 22 in 1899, retired from farming in 1944 at the age of 67, and

TABLE 1. FARM OPERATORS BY AGE AND COHORT, THIRTEEN NORTH CENTRAL STATES, 1890–1950

Cohort[a]	Number of farm operators by age,[b] census of—						
	1890[c]	1900[c]	1910	1920	1930	1940	1950
				Thousands			
1950							60.2
1940						71.4	338.8
1930					80.3	355.8	482.5
1920				113.5	385.8	504.4	482.0
1910			131.1	536.1	584.4	592.9	425.1
1900		92.0	545.9	620.4	562.0	478.1	297.3
1890	81.1	506.8	634.7	569.9	432.0	347.0	
1880	514.7	644.8	585.6	397.6	281.2		
1870	536.6	541.6	376.5	214.8			
1860	482.1	381.6	218.9				
1850 1840	562.8[d]	249.2					
Total	2,177.2	2,416.1	2,492.6	2,452.3	2,325.8	2,349.6	2,085.8

Source: Censuses of Agriculture.

[a] For definition of a cohort see text. Cohorts are identified by the year in which cohort members were 15–24 years of age.

[b] The figures in each column from top to bottom are the numbers of farmers for the following age groups: under 25, 25–34, 35–44, 45–54, 55–64, and 65 and over. The underlined figures for age 35–44 are used as a measure of size of each cohort.

Operators not reporting age have been allocated to age groups. For each state a linear relation between (a) age, and (b) those not reporting age as per cent of those reporting age, was obtained from the relevant data for tenants and full owners in the 1950 census. For example, in Nebraska average ages were 38.5 and 53.4, and those not reporting age were 4.9 and 6.1 per cent of those reporting. The relation was positive except for Kentucky and Missouri. From the positive relations, percentages and numbers not reporting age were estimated for each age group, and then the numbers were adjusted proportionately to the correct total for each state in each census. In the case of Kentucky and Missouri, those not reporting age were allocated to age groups in proportion to numbers reporting age.

Operators not reporting age were 5 per cent of all operators in 1950, 4 per cent in 1940, 3 per cent in 1930, and 1 per cent or less in the previous censuses. Allocation of them to age groups had only a minor effect on the relations described.

[c] Age data for 1890 and 1900 is only available for "occupants of farm homes." The totals differ only slightly from those for the farm operators in the same census, and are evidently considered to be equivalent figures by the census.

[d] Over 55 years of age.

farmed all his life in the North Central Region. Such a farmer would be counted in the five decennial censuses from 1900 to 1940, and he would be a member of the groups of farmers shown in the row for the 1900 cohort in Table 1. That is, he would be included among farmers under 25 years of age in 1900, 35-44 years of age in 1920, etc.

The population to which the above farmer belongs can be defined quite precisely. It is a population whose members have the following characteristics: (a) they were born in the decade 1875-1885, and (b) they were farming in the North Central Region at the time of at least one of the decennial censuses. The first characteristic makes it a cohort, the name given to such a group in population analysis. The various cohorts in Table 1 are

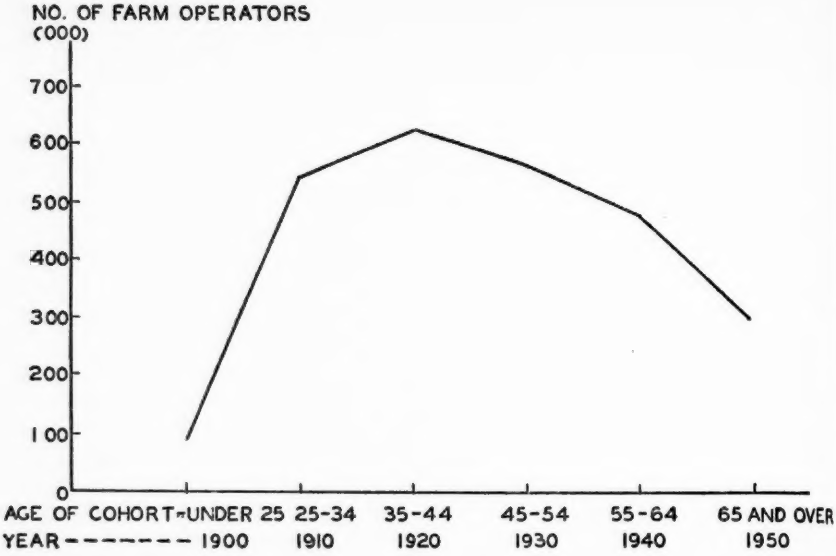

FIG. 1. NUMBER OF FARM OPERATORS IN THE YEARS INDICATED IN THE 1900 COHORT, 13 NORTH CENTRAL STATES.

labelled by the census year in which members of the group first became farm operators. Thus the group described in this paragraph is the 1900 cohort. (At the time of the 1890 census the members of the group were 5-14 years of age and thus too young to be farm operators.)

The cohort as defined is a distinct group; a farmer cannot belong to more than one of the cohorts shown in table 1.[2] It is an age group in the sense that its members were all born in the same period, and in that the range of age among group members is limited to ten years. Of course the age of the group is not fixed but increases over a period of time.

Cohort Pattern

The number of farmers in a cohort increases as cohort members become old enough to start farming and eventually begins decreasing for reasons of occupational change, retirement, and death. The information for one cohort is graphed in figure 1.

Usually the number of farmers belonging to a cohort reaches a maximum when the age of cohort members is 35-44. In table 2 the number of farmers 35-44 years of age is taken as the size of the cohort,[3] and the number

[2] Except a farmer who continues farming beyond the age of 74. Because the terminal age group is open-ended (65 and over), a farmer born in 1874, for example, would be counted in the 1890 cohort in all censuses up to 1950, but in that census, if still farming, he would be included in the 1900 cohort in the age group 65 and over.

[3] The population of all farmers belonging to a cohort, as defined above, will ex-

TABLE 2. NUMBER OF FARM OPERATORS IN VARIOUS AGE GROUPS EXPRESSED AS PERCENTAGE OF THE NUMBER OF FARM OPERATORS 35–44 YEARS OF AGE IN THEIR COHORT[a]

Cohort	Age Group					
	Under 25	25–34	35–44	45–54	55–64	65 and over
			Per cent			
1930	16.6	73.7	100.0			
1920	22.5	76.5	100.0	95.6		
1910	22.4	91.7	100.0	101.5	72.7	
1900	14.8	88.0	100.0	90.6	77.1	47.9
1890	12.8[b]	79.9	100.0	89.8	68.1	54.7
1880		79.8[b]	100.0	90.8	61.7	43.6
1870			100.0[b]	100.9	70.2	40.0
Average	17.8	81.6	100.0	94.9	70.0	46.6

[a] Based on data from table 1. Number of farm operators 35–44 years of age is assumed to measure cohort size.

[b] Data for 1890. Data to the right or above are for successive decennial census years.

of farmers at other ages is expressed as the percentage of the above age group. The results of this computation show that there is considerable similarity between different cohorts in the changes in the number of farmers over time.

The average cohort pattern shows that at age 15-24, 17.8 per cent of the members of the cohort become farmers, and the percentage of those farming rises to 81.6 when the members are 25-34 years of age. After age 35-44 the percentages of cohort members who are farming decline successively to 94.9, 70.0, and 46.6 per cent at the respective ages of 45-54, 55-64, and over 65.

However, the change in numbers of farmers in a cohort are net differences, which occur for several reasons. For example, the number of farmers belonging to the 1900 cohort increased between ages 25-34 and 35-44; this change occurred between 1910 and 1920. This increase might have taken place for any of the following reasons: (a) the members of the cohort entering farming exceeded those leaving farming. (b) the number of members of the cohort who farmed outside the region in 1910 and in the

ceed the number of farmers 35-44 years of age in that same cohort by the number of people in the following two groups: (a) persons who entered and left farming before the census taken when members of the cohort were 35-44 years of age, and (b) persons who entered and left farming after that census. Also, the definition used excludes from this population persons who entered and left farming within any period between decennial censuses. However, the closest approximation to the size of this population is the maximum number of farmers recorded in any census for each cohort.

In the case of two cohorts maxima occur at age 45-54, but in each case these maxima are only slightly larger than the respective number of farmers at age 35-44. Because of this fact, and because it was more convenient to define size at a uniform cohort age, the number of farmers at age 35-44 was used as a measure of size.

region in 1920 exceeded cohort members who made the opposite change of location, or (c) some combination of the above. It seems plausible, however, that interregional migrations of farmers nearly cancel out, and have little net effect on changes in the number of farmers in a cohort.[4]

The net changes in cohort members are also affected by the practice of the Census of Agriculture to enumerate only one person as an operator of any one farm, even if the farm is operated under a father-son arrangement or by a partnership of several brothers or other persons. In the case of a father-son arrangement it is likely that the father is enumerated as the operator as long as he participates in farm operations. In such an arrangement the son would contribute to an increase in the number of farmers in a cohort at the time when he becomes the sole operator (when his father retires) rather than at the time when he begins farming as a partner. In the case of two partners whose ages are similar, it is likely that one of the partners might never be counted by the Census of Agriculture.

Only indirect evidence is available about the relative magnitudes of the gross entries and withdrawals occurring within any ten-year period of cohort history; the evidence comes from variability in regional and state cohort patterns. Consider, for example, the smallest change in the cohort pattern, the net withdrawal of farmers between ages 35-44 and 45-54. On the average this decrease was 5.1 per cent, but small increases of 1.5 per cent and .9 per cent occurred in two out of six cohorts (see table 2). In the case of data for the 13 states of the region there were 57 decreases and 21 increases among the 78 observations for this stage of cohort history. The two regional increases and most of the increases in state data occurred in the periods 1890-1900 and 1930-40. In both periods there was a depression; also, in the earlier period settlement was still going on in parts of the North Central Region and this might have been a contributing factor.[5]

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[4] It is likely that the larger the region, the smaller is the number of those migrating in or out of the region in relation to those remaining in the region. It is also likely that the in-migration and out-migration of a region nearly balance out, and that the net migration between regions is small. If this is the case, then the changes in the number of farm operators in a cohort are primarily due to entry of young people into farming, and occupational change, death and retirement, and only in a minor degree due to net migration of farmers from one region to another (without occupational change). Shifts of tenants between adjoining counties separated by a state boundary are likely to lead to migrations which cancel out, while settlement in new areas is likely to result in migrations which do not cancel out. For the North Central Region as a whole it is not likely that net migration of farmers would have much effect in modifying the pattern shown by the cohorts.

[5] The 78 observations of state data are made up of changes between ages 35-44 and 45-54 in the six decades from 1890 to 1950. Of the 21 increases, eight occurred in 1890-1900, seven in 1930-40, and the other six were scattered among three decades. The net entries in 1890-1900 were in Michigan, Wisconsin, Minnesota, North and South Dakota (effect of settlement in northern portions of Lake States and Plains States?), Kentucky, Ohio, Indiana (effect of depression?). In 1930-40 the net

The fact that the average net withdrawal between cohort ages 35-44 and 45-54 was small and that net entries occurred suggests that the number of cohort members who entered farming might have been fairly large relative to the number of cohort members who left farming at this stage; therefore the usual net withdrawal might have been rather small in relation to the two kinds of gross changes. The small net entry during the depression decade 1930-1940 was very likely due to: (a) smaller than usual withdrawal from farming, and (b) larger than usual entry into farming (the back-to-the-farm movement of unemployed workers).

Exceptions to the average pattern also occurred in state data (but not for the region as a whole) in the stage between cohort ages 25-34 and 35-44. Out of 78 observations of state data there were 68 net entries, and 10 net withdrawals.[6] Again it seems likely that the number of farmers who left farming at this stage might be fairly substantial in comparison to the usually greater number of farmers who entered farming, so that occasional reversals of the net entry occurred.

There were no exceptions in either regional or state data to the direction of change at other stages of cohort history: the net entries between ages 15-24 (under 25) and 25-34, and net withdrawals between ages 45-54 and 55-64, and between 55-64 and 65 and over. Thus it seems likely that in the first case young people starting in farming far outnumbered other young people who quit farming, while in the other two cases retirements of farmers must have considerably outnumbered the entry of older people into farming.

It would, of course, be desirable to have information about total numbers (gross) entering and leaving farming by periods, to have the components classified by cause (death, retirement, and occupational change), and to have information about numbers of farm operators inclusive of partners. However, in the absence of such more complete data, cohort analysis should provide useful approximate measures, which aggregate some of the above components, but which in turn are less aggregated than the change in the total number of farmers.

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entries were in Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, and Missouri—states which either had large numbers of unemployed workers or in which it was relatively easy for the unemployed to find a small farm (as in the cutover areas of the Lake States). At the same time drouth and depression resulted in net withdrawals in the four Plains States and Iowa (the net withdrawal in Kentucky was extremely small).

[6] Nine of the ten cases of net withdrawal occurred in the four Plains States: North and South Dakota, Nebraska, and Kansas. Kentucky, in 1920-30, is the only other case. The drouth in 1930-40 seems to have contributed to net withdrawal in Nebraska and South Dakota. The ten exceptions are distributed among all the decades except 1940-50.

In addition, the thirteen state observations for 1945-54 show no exceptions to the usual direction of changes in cohort numbers.

Entry and Withdrawal as Components of Change in Total Number of Farmers

If we look at the changes occurring in a ten year period between decennial censuses, we can distinguish, in the usual case, three "younger" cohorts with an increasing number of farmers (those age groups of farmers than who are less than 35 years old at the beginning of the decade), and four "older" cohorts with a decreasing number of farmers.

We can use the total change in the first three cohorts as an approximate measure of the number of persons entering farming, and the change in the last four cohorts as an approximate measure of the number of farmers leaving farming. The rates of entry and withdrawal computed in this manner are net rates. Entry can be described more carefully as a difference between the number of "younger" persons entering farming and the number of "younger" farm operators leaving farming. An analogous description would be needed to define the meaning of net withdrawals from the "older" cohorts.[7] But while the rates of entry and withdrawal are net rates, usually these two components are considerably larger than the rate of change in total number of farmers (see table 4).

For example, for the period 1945-1954 (almost a ten year period from October of 1945 to January of 1954) table 3 shows an increase of 374.4 thousand among "younger" farmers, and a decrease of 701.1 thousand among "older" farmers. The net difference between this entry and withdrawal is equal to a decline of 326.6 thousand in the total number of farmers. If we translate the above three sets of figures into percentages of the total number of farmers at the beginning of the period (1945), then we can say that the decrease of 14.7 per cent is a net difference of a rate of entry of 16.8 per cent and a rate of withdrawal of 31.5 per cent.

Table 3 also shows the method of computing age-specific rates of withdrawal, which are rates of change for individual cohorts of "older" farmers. These rates are larger for older age groups; this simply indicates that as farmers get older, more of them are likely to retire.[8]

[7] Rates of withdrawal for all decades are computed as the changes in the number of farmers in the four oldest cohorts, whose members are over 35 years of age at the beginning of each decade. This is the case even in the two decades, 1890-1900 and 1930-40, in which a small increase occurred in the youngest of the included cohorts. Thus the same criteria for distinguishing "younger" and "older" farmers are used in each decade. The inclusion of the small increase in the youngest cohort in the computation of a rate of withdrawal from four "older" cohorts is not a contradictory procedure, since the rate of withdrawal is necessarily a measure of net changes.

[8] The age-specific rates provide the same information as the rates of change of successive stages in a cohort pattern. The only difference is that in the case of the cohort pattern, percentages are computed on the base of the number of farmers in the age group 35-44, whereas in the case of age-specific rates the base is the number of farmers in each age group at the beginning of the decade.

The rate of withdrawal is, of course, a function of the age-specific rates. The rate

TABLE 3. NUMBER OF FARM OPERATORS BY AGE AND RATES OF CHANGE, THIRTEEN NORTH CENTRAL STATES, 1945–1954

Age in 1945	Number of farm operators[a]			Rates of entry, withdrawal, and decrease[c]	Age-specific rates of withdrawal[d]
	1945 (1)	1954[b] (2)	Change 1945–1954 (3)	(4)	(5)
		Thousands		*Per cent*	*Per cent*
Under 15	—	35.6	35.6		
15-24	52.7	278.6	225.9		
25-34	332.5	445.4	112.9		
Total "younger" age groups	385.2	759.6	374.4	16.8	
35-44	497.4	451.8	− 45.6		9.2
45-54	557.9	386.7	−171.2		30.7
55-64	460.2	299.6	−160.6		34.9
65 and over	323.7	—	−323.7		100.0
Total "older" age groups	1,839.2	1,138.1	−701.1	31.5	
Total	2,224.3	1,897.7	−326.6	14.7	

Source of data: Censuses of Agriculture.

[a] Operators not reporting age allocated to age groups in proportion to number of those reporting age. Those not reporting age as per cent of all operators were 1.0 in 1945 and 1.4 in 1954.

[b] In any given row, age in 1954 is ten years more than age in 1945. Thus the data in each row pertains to a cohort. The cohorts cannot be traced to earlier periods because no age data was reported in the censuses of 1925 and 1935.

[c] Items in column 3 as per cent of the total number of farm operators in 1945.

[d] Decrease in the age group as per cent of the total number in the age group at the beginning of the decade (items in column 3 as per cent of items in column 1).

Changes in the Number of Farmers 1890-1954

Changes in this long period will be described with the aid of three types of measures: (a) cohort size and pattern, (b) rates of entry and withdrawal, and (c) age-specific rates of withdrawal. Each of the measures brings out somewhat different aspects of past changes.

Cohort size and pattern

Cohort sizes and patterns are primarily useful for describing some long-run aspects of the changes in the number of farm operators (see table 1 and figure 2). The data show that the 1920 cohort and the cohorts that follow were considerably smaller than earlier cohorts. But rates of change within individual cohorts were approximately the same, so that the numbers of older farmers in recent periods were largely determined by the sizes of the

of withdrawal is equal to a sum of cross products of (a) ratio of number of farmers in each of the oldest four age groups at the beginning of the decade to the total number of farmers, times (b) the corresponding age-specific rate of withdrawal. The age-specific rate for the oldest age group is taken as 100 per cent.

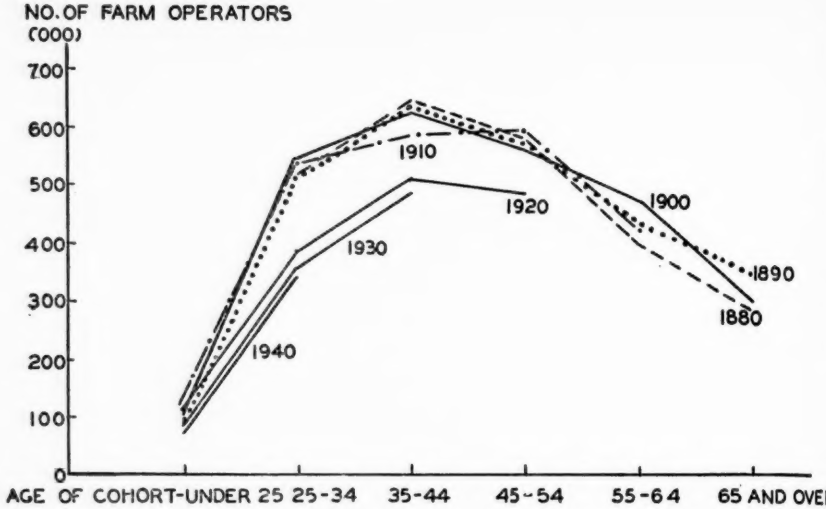

FIG. 2. NUMBER OF FARM OPERATORS IN SEVEN COHORTS, 13 NORTH CENTRAL STATES.

older cohorts. Since there is no evidence in figure 2 that withdrawals have increased, the impression is that decrease in numbers of farmers was primarily effected by the decline in the opportunities for beginning farmers. However, some evidence connecting rates of withdrawal to changes in numbers of farmers will be given below.

The four cohorts of 1880, 1890, 1900, and 1910 were all large and were approximately of the same size. These cohorts contributed the three oldest age groups of farmers in 1940, and the two oldest in 1950; at the time of the 1960 census their members will make up the oldest age group.

The influence of these four large cohorts can be seen in the large, and fairly similar, numbers of farmers in older age groups in recent censuses (see figure 2 and table 1). The number of operators 45-54 years of age from these cohorts were (in thousands), 586, 570, 562, 593; they were farming in 1910, 1920, 1930, and 1940, respectively. By contrast the number of farmers in the same age group in 1950 dropped to 482 because of the smaller size of the 1920 cohort. The number of operators 55-64 years of age from the four cohorts were 398, 432, 478, and 425 in 1920, 1930, 1940, and 1950 respectively. The number of operators 65 years and over from three of these cohorts were 281, 347, 297, in 1930, 1940, and 1950 respectively; the number in this age group in 1960 is likely to be in the neighborhood of the above three figures unless the extension of Social Security to farmers brings about a considerable difference in rates of retirement.

Rates of entry and withdrawal

The rates of entry and withdrawal in table 4 give the information about these two components of change in total number of farmers. The low rates

TABLE 4. RATE OF CHANGE IN THE TOTAL NUMBER OF FARMERS AND ITS COMPONENTS, 13 NORTH CENTRAL STATES, 1890–1954

Period	Change in total number of farmers[a]	Entry[a]	Withdrawal	
			Actual[a]	Estimated (constant age-specific rates)[b]
			Per cent	
1890–1900	11.0	29.8	18.8	N.A.
1900–1910	3.2	29.5	26.3	23.2
1910–1920	− 1.6	23.8	25.4	21.7
1920–1930	− 5.2	16.3	21.5	22.0
1930–1940	1.0	20.0	19.0	26.4
1940–1950	−11.2	19.3	30.6	29.8
1945–1954	−14.7	16.8	31.5	29.6

Source of data: tables 1 and 3.

[a] Computed in the same manner as rates column 4 of table 3. Difference between the rates of entry and withdrawal is equal to change in total number of farmers.

[b] Computed as sum of cross products of (a) number of farmers in each of the four oldest age groups at the beginning of the decade as per cent of the total number of farmers, and (b) average 1900–50 age-specific rates of withdrawal from table 5. The rate of withdrawal from the oldest age group is taken to be 100 per cent. Arithmetic averages of the age-specific rates of withdrawal for 1900–50 are 6.3, 26.0, and 34.5 per cent respectively for age groups 35–44, 45-54, and 55–64.

The changes in the rates of withdrawal in the last column are due entirely to changes in the age composition of farmers.

of entry after 1920 show the decrease in opportunities for beginning farmers. After that date, the rates of entry were considerably smaller than the rates of withdrawal, except in the depression decade of 1930-40, when rate of withdrawal dropped below the rate of entry and interrupted the trend of decreasing number of farmers.

Changes in rates of withdrawal are partly the result of changes in the age composition of farmers. Table 4 shows two kinds of rates of withdrawal: the actual rate and a rate computed on the assumption that the age-specific rates of withdrawal remained the same in all periods. The latter rate shows changes in rates of withdrawals due solely to the changing age composition of farmers. This rate increased after 1930 and reached a peak in 1940-50. The actual rate of withdrawal shows approximately the same changes over time as the computed rate; the biggest difference between the two rates occurred in 1930-40 (actual rate of withdrawal of 19.0 per cent, and computed rate of 26.4 per cent). This difference is a measure of the effect of the depression in lowering the rates of withdrawal of older farmers.

Age-specific rates of withdrawal

Table 5 presents the age-specific rates of withdrawal in relation to rates of change in total number of farmers. This is an attempt to check the effect of change in total number of farms on the number of farmers leaving

TABLE 5. AGE-SPECIFIC RATES OF WITHDRAWAL IN RELATION TO CHANGE IN TOTAL NUMBERS OF FARMERS, 13 NORTH CENTRAL STATES, 1890–1954

Period	Change in total number of farmers[a]	Age-specific rates of withdrawal[b]		
		35–44	45–54	55–64
		Per cent		
1890–1900	11.0	−0.9	20.8	N.A.
1900–1910	3.2	9.2	30.5	42.6
1910–1920	− 1.6	10.2	32.1	42.9
1930–1940	1.0	−1.5	14.9	19.7
1920–1930	− 5.2	9.4	24.2	29.3
1940–1950	−11.2	4.4	28.3	37.8
1945–1954	−14.7	9.2	30.7	34.9

Source of data: tables 1 and 3.

[a] Periods ordered by rate of change in total number of farmers, with a separate ordering for the pre-1920 and post-1920 periods. See text.

[b] Rates calculated in the same manner as age-specific rates in column 5 of table 3. Ages shown refer to age at the beginning of decade. Negative figures indicate the occurrence of net entry in the 35–44 years age groups.

farming; a close relation between these two rates would make it possible to estimate the age-specific rates of withdrawal that would prevail in the event of stability in total numbers of farmers.

Table 5 gives some support to the hypothesis that larger decreases in numbers of farmers are associated with increases in rates of withdrawal. But the number of observations is very small, particularly since there seems to be a shift in the relation from the pre-1920 to the post-1920 period. The age-specific withdrawal rates in the period 1890-1920 seem to be considerably larger than those in the following period, if we take into account the fact that in the early decades there are two increases and one small decrease in the number of farmers, while in the latter period there are three decreases and one small increase. This table does, however, show very clearly the low rates of withdrawal of older farmers in the depression decade of 1930-40.[9]

Components of Change 1945-54

This section attempts to estimate the increase in withdrawals and the decrease in entry due to increased competition for land implicit in the 14.7 per cent decline in number of farmers in 1945-54. For this purpose estimates are needed of "normal" age-specific rates of withdrawal that would have occurred in the absence of any change in the total number of farm-

[9] The divergent trends in age-specific rates of withdrawal are responsible for lack of relation between decreasing farm numbers and withdrawals in figure 2. The downward shift of age-specific rates after 1920, and the intervention of the low age-specific rates of 1930-40 between the higher rates before and after that decade are responsible for lack of cumulative increases in withdrawals in the curves for any one cohort.

TABLE 6. EFFECT OF DECREASE IN NUMBER OF FARMERS ON WITHDRAWALS IN 1945–1954, 13 NORTH CENTRAL STATES

Age in 1945	No. of farmers 1945 (1)	Age-specific rates of withdrawal			Number of farmers withdrawing[a]		
		Actual (2)	Normal[b] (3)	Associated with decrease in number of farmers[c] (4)	Actual (5)	Normal (6)	Associated with decrease in number of farmers (7)
	Thousands	*Per cent*			*Thousands*		
35–44	497.5	9.2	−0.8	10.0	45.6	−4.1	49.7
45–54	557.9	30.7	15.9	14.8	171.2	88.7	82.5
55–64	460.2	34.9	20.7	14.2	160.6	95.3	65.3
65 and over	323.7	100.0	100.0	0	323.7	323.7	0
Total Withdrawals					701.1	503.6	197.5
Withdrawals as per cent of total farmers in 1945[d]					31.5	22.6	8.9

Source of data: tables 3 and 5.

[a] Columns (5), (6), and (7) are equal to column (1) times columns (2), (3), and (4) respectively.

[b] Interpolated from the age-specific rates for 1930–1940 and 1945–1954. For example, for age-group 55–64 the age-specific rates of withdrawal (table 5) are 19.7 per cent in 1930–1940 and 34.9 per cent in 1945–1954, a difference of 15.2 per cent. The rates of decrease in total number of farmers in the same two periods are −1.0 (increase) and 14.7 per cent, a difference of 15.7 per cent. Assuming a linear relationship, this age-specific rate of withdrawal would increase by .96 (15.2÷15.7) for each 1 per cent change in the rate of decrease. The normal rate would be 20.7 (1.0×.96 above the 1930–1940 rate or 14.7×.96 below the 1945–1954 rate).

The negative "normal" rate for the age-group 35–44 indicates an estimate that a net entry would have occurred in this age group in the absence of change in the total number of farms.

[c] Column (2) minus column (3).

[d] Items in preceding line as per cent of 2,224.3 (see table 3).

ers. A consistent relation between rates of change in total number of farmers and the age-specific rates of withdrawal would give a basis for the estimate of such normal age-specific rates of withdrawal, but, unfortunately, the data available in table 5 are too few and not sufficiently consistent. Nevertheless, for purposes of illustration, it is assumed that the data for 1930-40 and 1945-54 can be used to obtain the necessary relation. The purpose of these computations is to illustrate a method, and to estimate, even if very approximately, the size of groups of farm people affected by decrease in number of farmers.

The estimated normal age-specific rates of withdrawal are slightly larger than the 1930-40 rates and considerably smaller than the 1945-54 rates (see table 6). These normal age-specific rates applied to the number of farmers in 1945 in the relevant age groups yield an estimate that only 22.6 per cent of all operators would have withdrawn from farming in the period 1945-54 had the number of farmers remained stable. The actual rate of withdrawal was 31.5 per cent. The difference of 8.9 per cent is an estimate of increased withdrawal of older farmers.

Also, in the event of stability in the number of farmers, a rate of entry of young people of 22.6 per cent would have been needed to replace the

withdrawing older farmers. The difference between the above rate of replacement and the actual rate of entry of young farmers (16.8 per cent) is 5.8 per cent. This is an estimate of the decreased entry of young people, and this measure together with the estimate of increased withdrawals of older farmers is equal to the 14.7 per cent decrease in the total number of farmers in 1945-54. Or we can say that approximately 60 per cent of the decrease in the number of farmers is made up of the increased withdrawal of older farmers, while decreased entry of young farmers is equal to the remaining 40 per cent (8.9 and 5.8 as per cent of 14.7).

Further, a comparison of the actual number of young people entering farming with the number of farm boys in the same cohort can give an estimate of the number of farm boys for whom opportunities to operate farms did not exist.[10] Most of the young people who entered farming in 1945-54 came from a cohort whose members were born in the decade 1920-30. In 1930 in the North Central Region there were 1,185 thousand farm boys in this cohort (under ten years of age).[11] In 1954, at age 25-34, 278.6 thousand members of this cohort were farming (see table 3). By 1965, when the number of farmers in this cohort should reach maximum, some 340 thousand of them might be farming,[12] which would mean that the remaining 845 thousand farm boys from this cohort would end up in occupations other than operation of farms. In comparison, the increase in the number of older operators who withdraw from farming is estimated at 200 thousand (see table 6), or approximately one-fourth of the number of farm-reared boys leaving farming.

The above calculations are intended solely to measure the size of two groups of farm people affected by decrease in the number of farmers. Even as measurements they suffer from several limitations: the fairly arbitrary way in which "normal" age-specific rates of withdrawal are computed and the fact that the rates of entry and withdrawal are net measures. These net rates underestimate both the number of young people who become farm operators and the number of operators who withdraw from

[10] This comparison assumes that most beginning farmers are farm-raised males, which is believed to be the case.

[11] *Census of Population,* Vol. II, Second Series, Characteristics of Population, State Reports, table 7.

[12] Estimates based on average cohort pattern (see table 2). According to that pattern, the number of farmers of age 25-34 is equal, on the average, to 81.6 per cent of the number of farmers in the same cohort at age 35-44. In this case, 278.6 thousand divided by .816 gives approximately 340 thousand.

This estimate implies that 29.5 per cent of this cohort of farm boys will become farmers (340 as per cent of 1,185). It is interesting to compare this data with the preceding cohort of farm boys in the period 1910-20. In 1920 the regional total of farm boys in this cohort was 1,397 thousand; in 1954 the number of farm operators (age 35-44) in this cohort was 445.4 thousand. (See *Census of Population, op. cit.* and table 3). This would indicate that 31.9 per cent of the farm boys born in 1910-20 became farm operators.

farming. Thus, the use of net rates overestimates the number of farm boys who leave farming without any experience as farm operators, and underestimates the number of those who leave farming after having become farm operators.

In addition the mere comparison of the number of farm boys who leave agriculture without ever having operated a farm, and the number of farm operators who are forced out or attracted out of farming does not measure the relative magnitudes of different types of adjustment since neither group is homogeneous. Those who leave without becoming operators include young people who would like to farm but cannot find farms, those who prefer other occupations, and some who are taken out of rural areas by the migration of their parents before reaching the age of occupational choice. The increased withdrawal of farm operators includes tenants who have lost their leases and are unable to find other farms, farmers who want to but cannot enlarge their operations, and farmers who prefer the opportunities they find outside of farming.

The types of opportunities to which farm people have to adjust vary with each farm family. Different families would be satisfied with farms of different size. The decisions to enter, to remain in, or to leave farming are of course made with reference to the specific alternatives facing each family; sometimes the circumstances are such that no farm can be found, while in other cases farming opportunities are available but are not attractive. It should be clear that the measurements made above do not describe the complexities of the occupational decisions of farm people.

Suggestions for Possible Uses of Cohort Analysis of Farm Operators

Cohort analysis of the changes in the number of farmers in the 1950-60 decade should show the continuing consequences of decrease in numbers of farmers as well as the impact of the extension of Social Security to farmers. For the latter purpose the age-specific rates of withdrawal might be informative.

Data presented above described changes in the number of farmers belonging to various cohorts. But it would also be possible to study changes in the attributes of members of a cohort, if these attributes were cross-classified with appropriate ages in successive censuses.[13] Analysis of char-

[13] Such studies could be made from the unpublished data already collected by the Censuses of Agriculture. The only requirement would be to tabulate relevant attributes of farmers for each age group, and to use age group limits for successive censuses in such a manner as to group together members of the same cohort. For example, if comparisons were to be made for 1950, 1954, and 1960, then the 1950 and 1960 data could be tabulated for age groups: under 25, 25-34, etc.; but in that case the 1954 data would have to be tabulated for age groups under 20, 20-29, etc. In that case, one of the cohorts would be made up of farmers 25-34 years of age in

acteristics of cohort members could be used to show variables associated with age (life cycle of farmers), such as tenure (the agricultural ladder), and size of farm. It would also be possible to identify the difference between older and younger farmers in enlarging farms, acquiring farm machinery, and other changes in farm organization.[14] For example, changes in the average acreage held by members of the same cohort could be obtained from a cross-classification of age and average (or total) acreage. Also, aggregate net acreage given up by older farmers and taken up by younger age groups could be calculated from the same cross-classification. It seems quite likely that studies of this kind might provide useful insights about changes occurring in U.S. agriculture and about the life cycle of farmers.

Summary

Cohort analysis was used to analyze Census of Agriculture data about numbers and age of farm operators in North Central States. The methods

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1950, 30-39 in 1954, and 35-44 in 1960. Other cohorts could be followed through the three censuses in a similar manner.

A small but desirable addition to published census information would be a breakdown of the number of farmers by five-year age groups. This would make it possible to trace the number of farmers in the same cohort through both the quinquennial and decennial censuses.

[14] It is possible to distinguish conceptually (a) changes connected with the life cycle from (b) secular changes affecting agriculture which have a differential effect on various age groups. For example, in the case of size of farm, it is likely that younger and middle-aged farmers are most active in enlarging their farms, but that these changes are in turn superimposed on a life cycle pattern of size of farms (size increasing with age among younger farmers and then decreasing among older farmers). With suitable data from successive censuses it might be possible to test both hypotheses.

Tenure and age cross-classification is already available for all censuses since 1890, except for 1925 and 1935. Tenure changes of cohort members, obtained from this kind of data, have been used in several studies of the agricultural ladder. A recent study is by Frank H. Maier, Sheridan T. Maitland, and Gladys K. Bowles, *The Tenure Status of Farmworkers in the United States,* Tech. Bul. No. 1217, U.S. Dept. Agr., 1960. Other similar studies are C. Arnold Anderson and Mary Jean Bowman, *Tenure Changes and the Agricultural Ladder in Southern Agriculture,* Ky. Agr. Exp. Sta. Res. Bul. 634, 1955; Carl C. Taylor, Louis J. Ducoff, and Margaret J. Hagwood, *Trends in the Tenure Status of Farm Workers in the United States Since 1880,* U.S. Dept. Agr., Bur. Agr. Econ. (mimeo), 1948; John D. Black, Marion Clawson, Charles R. Sayre and others, *Farm Management,* New York: Macmillan, 1947, pp. 71-75, and John D. Black and R. H. Allen, "The Growth of Farm Tenancy in the United States," *Quar. J. Econ.,* May 1937.

As far as I know, no studies of changes in other characteristics of cohort members have ever been made.

It is not possible to study changes in average size of farm of cohort members from published census data. Age groups by size of farm (but not average size of farm by age group) were reported in the 1945 census (by states) and the 1950 census (by states and economic areas), but were not reported in the 1954 census. Since the first two censuses were only five years apart, the reported ten-year age limits of age groups are not suitable for cohort analysis.

employed bring out several different aspects of change in total number of farmers.

(1) The changes in the number of farmers in individual cohorts show the persistence in the patterns of change within the cohort; the relation between age and the proportion of people within a cohort entering and leaving farming has not shown any cumulative change over long periods of time. The large contrasts are between cohorts: the number of farmers in the cohorts entering farming since 1920 is considerably smaller than in older cohorts. The large number of older farmers in the more recent censuses can be explained partly by the large size of the cohorts of farmers who entered farming before 1920.

(2) For ten-year periods, changes in two groups of cohorts are combined to form net rates of entry (change within three younger cohorts) and withdrawal (change in the remaining four older cohorts). The net difference of these two rates is equal to the rate of change in total number of farmers, and thus the two rates can be taken as components of the latter. Since 1920 decreases in number of farms have been accompanied by relatively low rates of entry and increasing rates of withdrawal. The exception was the depression decade 1930-40, when very low rates of withdrawal resulted in a slight increase in the number of farmers.

(3) The rates of withdrawal mentioned above are partly dependent on the age composition of farmers; they are likely to increase when a larger proportion of farmers is in older age groups. Measures independent of the age compostion are the age-specific rates of withdrawal computed separately for each of three cohorts of older farmers.

(4) The ability to estimate age-specific rates of withdrawal which might occur in the event of no change in the total number of farmers ("normal" rates) would make it possible to estimate the increase in the rate of withdrawal and the decrease in the rate of entry that are associated with a decrease in the total number of farmers. Such estimates were attempted for the period 1945-54.

COST-SIZE RELATIONSHIPS FOR CASH CROP FARMS IN A HIGHLY COMMERCIALIZED AGRICULTURE*

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THIS paper concentrates on estimating the long-run planning curve for farms in a highly commercialized cash crop area of California. For this purpose, both research approaches traditionally employed in economies of size studies are examined: (1) budgeting and linear programming of synthesized operations of different sizes, and (2) regression analysis based on observations from a sample of farms. The empirical results derived therefrom may be indicative of future findings in other large-scale farming areas of California and the United States, perhaps providing insight into the perennial question of "how big" commercial farms might become in the forseeable future.

Theoretical Considerations

Theoretical concepts underlying economies of scale are well documented in economic literature.[1] Thus, following is only a brief summary of the concepts which provide the foundation for the empirical findings. For the simple case—a single product (output) produced with several factors (inputs)—the problem is to establish a unique cost-output curve wherein *costs are minimized for each output level.* This unique long-run or planning curve (usually expressed in terms of *average costs*) is derived as the envelope to a series of short-run cost curves, each of which corresponds to farms or plants of different "fixed" sizes.

Concepts underlying cost economies for firms producing multiple products (ordinarily the realistic case in agriculture) represent a logical extension of the single product case. With multiple products, a total cost envelope surface can be visualized representing the minimum cost of producing all levels and combinations of products. Conceptually this relationship permits examination of changes in total costs as output is expanded along any trace or path on the *n*-dimensional multiple product cost surface. While such a surface might be approximated empirically,[2] the procedure would be quite costly and cumbersome with a large number of products

* Giannini Research Foundation Paper No. 206. The authors acknowledge the constructive comments of colleagues B. C. French and G. A. King on an earlier draft of this paper.

[1] For example see: Boulding, Kenneth E., *Economic Analysis*, Harper & Brothers, New York, rev. ed., pp. 671-90; and Stigler, George J., *The Theory of Price*, Macmillan Co., New York, rev. ed., 1952, pp. 134-47.

[2] For example, see French, B. C., L. L. Sammet, and R. G. Bressler, "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears," *Hilgardia*, 24:663, July 1956.

(e.g., 5-10 crops). Further, large areas of such a surface would be irrelevant because of acreage allotments, contractual arrangements, diseases, and rotational restrictions.

A relatively simple alternative procedure used here is to develop detailed costs along a few selected relevant traces on the multiple product surface. This procedure is illustrated with the simplified two-product cost surface shown in Figure 1. Lines I-I′, II-II′, III-III′, and IV-IV′ in Figure 1 refer to production possibility or iso-cost curves on the total cost envelope surface. Empirically, the production possibility curves are formed from

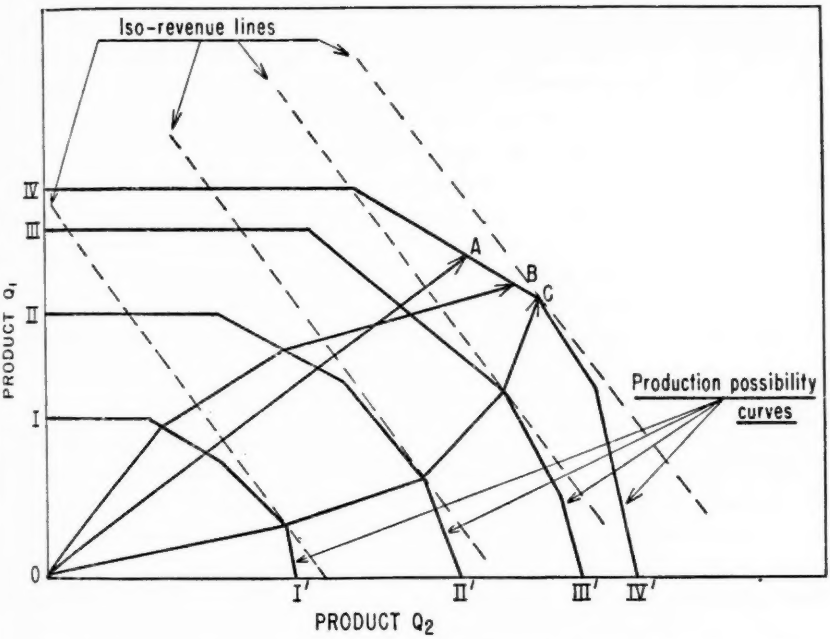

FIG. 1. ALTERNATIVE PRODUCT COMBINATION "TRACES" ON A HYPOTHETICAL TOTAL COST SURFACE.

linear resource restrictions for fixed plants or farms of different sizes.[3] Analyses shown later for three separate multiple product mix situations—distinguished as *Budget I, Budget II,* and *Linear Programming*—are analogous to the three "traces" illustrated for the two-product case in Figure 1. *Budget I* (corresponding to trace OA, Figure 1) assumes the *same* cropping system (fixed multiple product mix) over the entire output range.

[3] Algebraic and graphic derivation of such production possibility curves is frequently presented in linear programming literature. For example, see: Heady, E. O. and Wilfred Candler, *Linear Programming Methods,* Iowa State College Press, 1958, Chap. 2.

Budget II (corresponding to trace OB, Figure 1) assumes a series of *changing* cropping systems (product mixes) typical of farms of different sizes. The *Linear Programming* situation (corresponding to trace OC, Figure 1) allows the cropping system (product mix) to change in optimum fashion as output expands. This situation is of particular interest because, given product prices, it specifies optimum expansion possibilities, consistent with the institutional and economic realities facing farmers.

Later regression analyses can be related only approximately to Figure 1. Two general problems arise in deriving planning curves by fitting equations directly to farm observations: (1) Most firms are technologically inefficient in the sense that their product mix could be produced more cheaply; i.e., the farm observations lie "off" the envelope surface entirely, and (2) the firms are producing a range of product mixes not corresponding directly to one exact product trace. The second problem makes the product mix uncertain in the regression analyses presented later; however, the traces derived probably correspond most closely to the typical product mix of Budget II (trace OB, Figure 1).

Measuring output for multiple product firms

A question arises concerning the appropriate method of presenting later empirical results for the multiple product situations. It would be useful to study cost economies along the particular traces of interest and also to compare cost economies among the various traces. While the above discussion has been in terms of *total* cost, cost economies are more easily comprehended and generally presented in terms of *average* costs. However, the multiple product situations present the problem of finding an appropriate measure of output, particularly when the product mix changes (is nonhomogeneous) as output expands. Without a measure of *output,* no meaningful average total cost surface exists, either conceptually or empirically. In this study product prices (P_i) are specified as product (Q_i) weights; thus, total revenue

$$\left(\sum_i P_i Q_i = TR \right)$$

becomes the index of output and average cost is expressed as total cost per dollar of total revenue ($TC \div TR = ATC$). While any weighting system admittedly is somewhat arbitrary, a precedent for this procedure is found in determining total costs by weighting optimum input combinations by factor prices. Given total revenue (TR) as a measure of output, comparisons can be made of ATC ($TC \div TR$) for any conceivable trace on the total cost surface.

The critical factors in interpretation of the long-run average total cost curve are the break even point ($TC = TR$ or $ATC = AR$) and the minimum

ATC point. Ordinarily, this cost curve is independent of product price. How does inclusion of product price in the output measure affect the nature of the average cost curve? In the case of a single product or multiple products in fixed proportions, use of *TR* as a measure of output does not affect the critical break even or minimum points, *assuming constant product prices*. That is, by transforming output into *TR*, the minimum point on the *ATC* curve occurs at the same combination and level of products as minimum total cost per unit of the physical product or fixed product combination. Neither do changes in the product price *level* (relative product prices constant) affect the level and combination of products corresponding to the minimum point on the *ATC* curve. (Of course, with changes in the product price level, the minimum *ATC* occurs at a different *TR*, but still corresponds to the same physical product quantities). Also, in the more complex case where multiple products expand in nonconstant proportions, changes in the price level (relative product prices constant) do not change the physical product combination and level corresponding to the minimum point on the *ATC* curves. Thus, with constant *relative* product prices and assuming changes in the price *level* only, use of *TR* as a measure of output does not distort the cost economies relationship. Therefore, in the following empirical sections, all individual cost curves and comparisons are expressed in terms of *ATC* in relation to output (*TR*).

Empirical Analysis of Cost Relationships

Description of farming area

The California area studied is characterized by highly commercialized farming similar to that in other irrigated field crop areas of California. Soils are highly productive with most of the land fully developed for irrigation. Soil, water, and climatic conditions allow a wide range of crop alternatives, thereby suggesting the multiple product situation as the relevant theoretical structure. Large-scale machinery and equipment are prevalent. Renting is common, especially for larger operations; thus share-renting is the tenure arrangement assumed throughout the analysis. While many farms are relatively large, they are usually operated by a single individual or family partnership. Management capacity of the operators is generally above average.

A 1959 sample of 37 farms in the area[4] revealed operations ranging from 71 to 4,000 acres (mean, 842 acres) with farm output (*TR*) ranging from \$8,500 to \$360,000 (mean, \$149,000). Renter total revenue per acre ranged from as low as \$35-40 for barley to \$400-450 for canning tomatoes (see Table 1 for typical cropping systems, yields, prices, and renter total reve-

[4] For additional details see Dean, G. W., and H. O. Carter, *Cost-Size Relationships for Cash-Crop Farms in Yolo County, California*, Giannini Found. Mimeo. Rept. No. 238, Dec. 1960.

nue). The average labor cost per farm was nearly $50,000, reflecting substantial acreages of labor-intensive tomatoes and sugar beets as well as large farm sizes; the market value of machinery investment per farm averaged about $37,000. Variable cash expenses (other than labor) averaging about $33,000 per farm further illustrate the highly commercialized operations studied.

Budgeting and linear programming approach

The 37 sample farms are divided into four acreage classes: 160-320 acres, 320-640 acres, 640-1200 acres, and over 1200 acres. Four machinery and equipment combinations are then specified, representing those typical of farms in each acreage category. In the study area, machinery and equipment (particularly power machinery) appear to constitute the most realistic "fixed" resource limiting short-run expansion in farm size; all other resources, including land, are considered variable. Therefore, the capacity of power machinery (measured in tracklayer and wheel tractor operating hours by months) ultimately limits expansion in each of the four size categories. Aside from power machinery, the major limitations on size appear to be institutional restrictions (e.g., government allotments, contracts, and landlord requirements regarding use of rented land) and crop rotation requirements. Labor is considered a variable resource because Mexican Nationals are presently available in essentially unlimited supply at prevailing wages, providing the farmer arranges for their hire reasonably in advance.[5] Land is considered variable because additional

TABLE 1. CROPPING SYSTEM DATA ASSUMED IN BUDGETS I AND II

Crop	Unit	Yield per acre[a]	Price per unit	Budget I		Budget II							
				Percent of rotation in each crop[b]	Share renter's total revenue per acre of rotation[c]	Percentage of rotation in each crop by size group[d]				Share-renter's total revenue per acre of rotation[c]			
						I	II	III	IV	I	II	III	IV
			dollars	*percent*	*dollars*	*percent*				*dollars*			
Alfalfa	tons	7.3	22.00	25	30.11	15	20	25	30	18.07	24.09	30.11	36.14
Barley	cwt.	31.2	2.00	15	5.62	10	20	20	25	3.74	7.49	7.49	9.36
Milo	cwt.	43.0	2.10	15	10.16	15	15	20	20	10.16	10.16	13.54	13.54
Sugar Beets	tons	21.6	13.00	20	44.93	20	15	15	10	44.93	33.70	33.70	22.46
Tomatoes	tons	22.5	22.00	25	105.19	40	30	20	15	168.30	126.22	84.15	63.11
All Crops	—	—	—	100	196.01	100	100	100	100	245.20	201.66	168.99	144.61

[a] Normal yields per acre from sample. Yields per acre were not greatly different among size groups, and no trend with size was apparent. There also was little evidence to support the hypothesis of different prices received on farms of different sizes.
[b] Overall averages based on sample of farms and adjusted to reflect a feasible individual farm rotation.
[c] Share-renter's total revenue based on percentage share of each crop in the rotation. Rent paid to the landlord for the above crops are: alfalfa 25%, barley 40%, milo 25%, sugar beets 20%, and tomatoes 15%.
[d] Rotation for different size groups based on farm sample information and adjusted to reflect a feasible individual farm cropping system (see text).

[5] Attempted unionization of farm labor in California may change this assumption in the future.

land usually can be rented without difficulty if the renter has a good reputation, pays prevailing rental rates, and is willing to expand operations in a noncontiguous manner geographically.[6] Operating capital also is considered variable in the analysis. In effect, however, the quantity of operating capital used for labor and other variable resources determines how far the farmer extends output (*TR*) on each short-run cost function. The empirical procedure is to budget or program costs for each of the four ma-

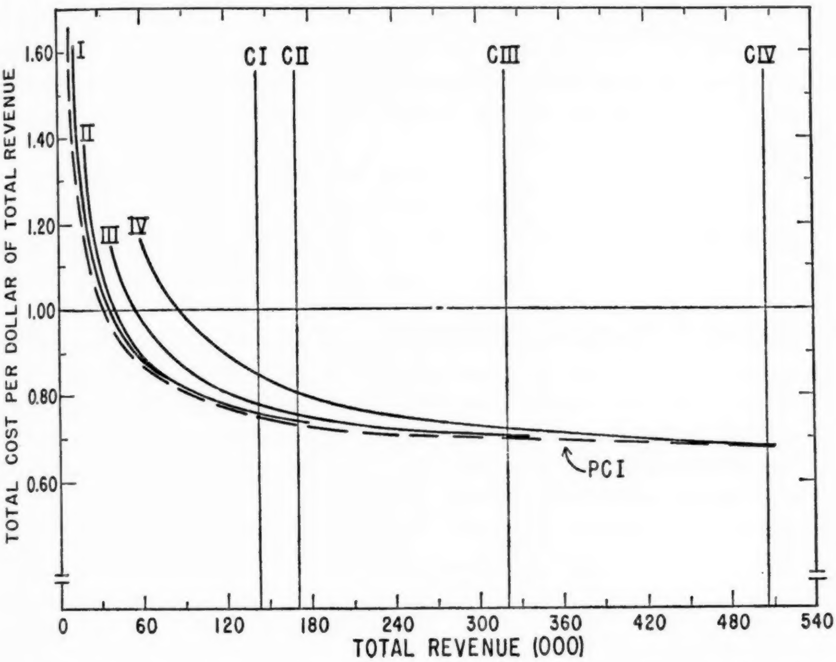

FIG. 2. AVERAGE TOTAL COST CURVES FOR FOUR MACHINERY COMBINATIONS AND ENVELOPE OR PLANNING CURVE (BUDGET I, RENTED SITUATION).

chinery size groups, then approximate a planning curve as an envelope to the four short-run curves.

Cost curves for typical product mixes (budgeting). Fixed and variable machinery costs, labor costs, and all other costs (seed, fertilizer, sprays, electricity, etc.) were compiled to arrive at operator average total costs ($TC \div TR$) for share-rented farms of different sizes. Figure 2 summarizes the resulting average total unit cost curves for the Budget I (constant

[6] Increased costs associated with operations separated geographically are not explicitly introduced within each size category as size expands. However the machinery inventory on the larger farms includes equipment associated with widely separated operations (e.g., carryalls and flat-bed trucks to move equipment).

product mix) situation. Curves I, II, III, and IV are short-run average cost curves corresponding to each of the four machinery combinations.[7] Curve PC I, drawn as an envelope to the four short-run average cost curves, declines sharply to an output of about \$150,000-\$180,000 (approximately 750-900 acres), then declines slowly throughout.

Budget I serves as a convenient starting point in the analysis. However, prevailing cropping practices are better represented by Budget II, where proportionately more lower value crops (e.g., barley and milo) are included in the rotation as size increases (see Table 1). Primary reasons for this change are (1) fixed sugar beet acreage quotas per grower, (2) high risk on tomatoes and (3) more complete mechanization of the lower value crops. The planning curve for Budget II (shown in Figure 4) is nearly identical with that for Budget I.

Thus, under either Budget I or Budget II, increasingly greater profits per unit are realized as size expands beyond 180 acres. However, operations of 750-900 acres have gained most of the cost economies available and can compete closely on a *per unit* cost and profit basis with larger farms.

Cost curves for an optimum product mix (linear programming). The above analysis assumed "typical" product mixes. Linear programming is now used to derive cost functions which—under existing efficient technology for each crop, and within specified resource, rotation, and institutional restrictions—represent "optimum" or minimum-cost product mixes (cropping systems) for attaining each level of output.

Specifically, renter output (*TR*) is expanded in optimal fashion (least cost per dollar of output) by continuous increases in operating capital for each of the four typical machinery combinations.[8] Ultimate expansion in each size group is limited by the power machinery available in critical time periods to perform field operations. However, expansion is also consistent with the following restrictions:

(1) Rented land is composed of a typical 2:1 ratio of Yolo A (light-textured) soils to Yolo B (heavy-textured) soils.

[7] As mentioned earlier, the factor primarily limiting short-run farm size expansion is the operator's power equipment available for such field operations as heavy tillage, planting, and cultivating (custom work can be obtained for the major harvesting tasks). Thus, short-run cost curves I, II, III, and IV are terminated at the maximum acreage consistent with the "capacity" of power equipment (i.e., at CI, CII, CIII, and CIV, respectively). Capacity is determined by computing hours of "power time" available per time period (based on size and number of tractors, number of nonwet days, and a 10-hour work day), compared with crop requirements by time periods.

[8] See Heady, E. O., and Wilfred Candler, *op. cit.*, Chap. 7. Variable capital programming was used in deriving the greatest output (total revenue) per unit of operating capital (variable cost) at all cost levels. In this case, operating capital is used for fuel, oil, labor, and associated variable inputs. A similar application is made by Barker, Randolph, *Agr. Econ. Res.*, 12:6-12, Jan. 1960.

(2) Nematode disease problems (and, secondarily, contract limitations and high risk) restrict tomato acreage to 25 percent (one year in four) or less on Yolo A land and 20 percent (one year in five) or less on the heavier Yolo B land.

(3) Also because of nematode problems, sugar beet acreage is restricted to 25 percent or less on both Yolo A and Yolo B land.

(4) Sugar beet acreage is restricted by a fixed government allotment for each grower. In accordance with sample information, the sugar beet allotment is increased less than proportionately for each of the four farm size categories.

(5) A minimum of 25 percent of both Yolo A and Yolo B land must be planted to alfalfa.

(6) The landlord requires that all rented land must be cropped; i.e., no land left fallow, although tomatoes can be subleased.

(7) The landlord requires a minimum of 20 percent of the rented land planted to the high value crops—tomatoes, sugar beets, or some combination of the two.

Linear programming is used to select the combinations and levels of 28 alternative crop activities which maximize total revenue per unit of cost, consistent with the above restrictions.[9] Short-run total cost functions are thus derived for each of the four machinery-size combinations. Total fixed cost is, by definition, a constant for all levels of output in each of the short-run situations. Total variable cost (*TVC*) for each level of output is derived directly by the programming solutions. Crops with the greatest revenue per dollar of variable cost enter the optimum solutions at low output levels. As output increases and machinery capacity becomes restrictive, the optimum solutions shift to crops providing lower returns per dollar of operating capital, but greater returns per hour of limited power equipment. This shift causes output to increase at a decreasing rate, and therefore *TVC* in relation to output to increase at an increasing rate.[10]

Figure 3 summarizes the average cost functions derived from linear programming. The short-run cost curves (I, II, III, IV) are U-shaped because increasing *AVC* (average variable costs) eventually outweigh declining *AFC* (average fixed costs). Short-run curve IV lies on or above III over the entire output range, because (1) total and therefore average fixed machinery costs are considerably higher for machinery combination IV and (2) the sugar beet acreage allotment does not increase proportionately

[9] For these optimum cropping systems and other details see Dean, G. W., and H. O. Carter, *Guide to Profitable Cropping Systems for Yolo County Farms*, Giannini Found. Res. Rept. No. 242, April 1961.

[10] It is emphasized that the increasing *TVC* stems from the changing product mix. Under the linearity assumptions of linear programming, *TVC* would increase at a constant rate (constant *AVC*) if the product mix (rotation) were constant.

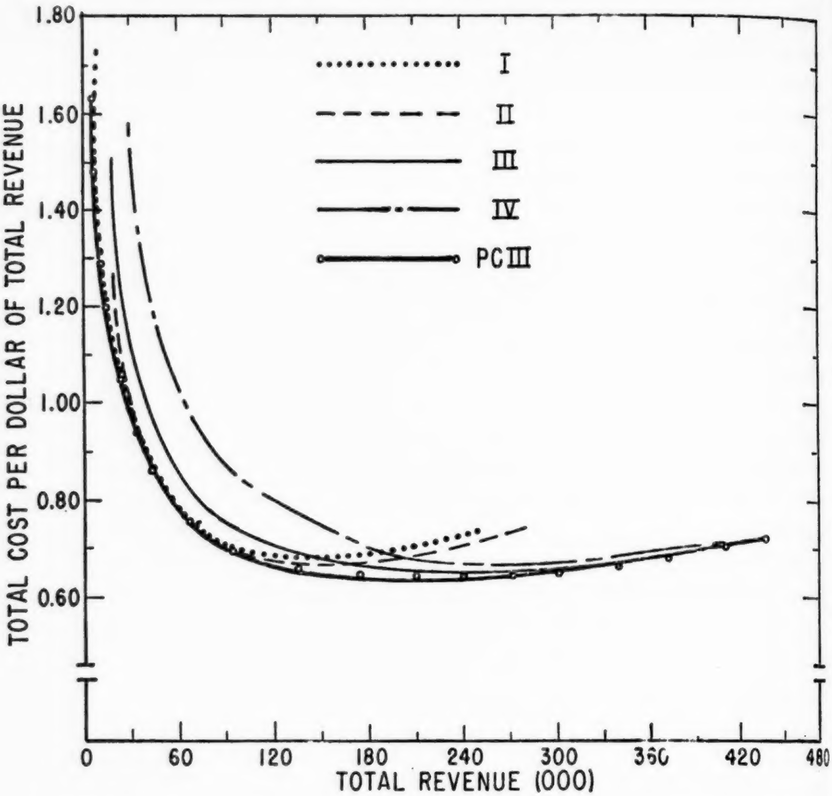

FIG. 3. AVERAGE TOTAL COST CURVES FOR FOUR MACHINERY COMBINATIONS AND ENVELOPE OR PLANNING CURVE (LINEAR PROGRAMMING).

with size. The envelope curve (PC III) is thus U-shaped, declining sharply to about \$0.70 at \$100,000 output, falling to a minimum of \$0.65 at \$240,000 output, then increasing gradually to about \$0.72 at an output of \$440,000. Hence, farms with output beyond \$240,000 (1,420 acres) begin to experience diseconomies (rising costs per dollar of total revenue) because of the institutional and economic limitations forcing a change in product mix. This relationship may explain the fact that few farms are actually operating in the extremely high output ranges.

Derivation of long-run cost curves with regression analysis

The method of synthesizing costs (using simple budgeting or linear programming) can be criticized on grounds that the assumptions employed tend to "build in" cost economies of size. Synthesized costs are based on engineering efficiency and may ignore such subtle sources of economies and diseconomies as specialization or diseconomies in labor use as size increases. Limitations of synthesized costs suggest the alternative possibility

of deriving cost functions directly from farm sample data. This method has appeal because the sample observations reflect all important cost elements, including those possibly omitted from the synthesized costs.[11] Therefore, for purposes of comparison, regression analysis is used in (1) fitting cost functions directly to actual cost data for individual farms, and (2) deriving production functions as a basis for estimating short-run cost curves.

Cost curves derived directly from farm cost data. A major disadvantage of the regression technique for deriving cost curves directly is one of statistical measurement often referred to as the "regression fallacy."[12] That is, individual farmers with similar fixed resources operate at different output levels because of limitations on other resources, risk and uncertainty and related reasons; a regression equation fitted to a scatter of average cost observations passes through these points and therefore gives a cost curve which lies above the "true" envelope curve.[13]

For purposes of direct comparison between regression and budgeting techniques, the regression model must be formulated as conceptually comparable to its budgeted counterpart. Thus, a procedure is required that will "shift" the scatter of individual observations to the minimum points on their respective short-run cost curves. One measurable factor causing farmers to operate at other than minimum-cost output levels is under-capacity use of machinery. Accordingly, a multiple regression model is formulated in equation (1) relating total cost to output and percentage of available machinery capacity utilized. The capacity measure is introduced as a shift variable; when this variable is set at 100, or full capacity, the resulting curve should correspond more closely to the usual concept of an envelope curve.[14]

$$(1)\quad TC = 17.32Q^{\overset{(21.42)}{.7475}}\,C^{-\overset{(0.25)}{.0131}} \qquad R^2 = .94,\ N = 37$$

TC = total costs (including the same categories of variable and fixed costs used in the synthesized analysis).

Q = renter share of output measured in total revenue.

C = percentage of available machinery capacity utilized.

t-values are given in parentheses.

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[11] For an excellent discussion of alternative methods of deriving economies of scale curves see Bressler, R. G., Jr., "Research Determination of Economies of Scale," *J. Farm Econ.*, 27:526-39, Aug. 1945.

[12] See Stigler, George J., *op. cit.*, pp. 143-44.

[13] Despite these difficulties, some argue that regression analysis provides a simple, direct method and may be useful if the slope and minimum points of the regression curve are similar to those of the "true" envelope curve. See: Heady, E. O., G. L. Johnson, and L. S. Hardin (eds.), *Resource Productivity, Returns to Scale, and Farm Size*, Iowa State College Press, Ames, Iowa, 1956, pp. 79-80.

[14] For a more detailed regression analysis utilizing "capacity" variables, see Phillips, Richard, "Empirical Estimates of Cost Functions for Mixed Feed Mills in the Midwest," *Agr. Econ. Res.*, 8:1-8, Jan. 1956.

Although the regression coefficient for machinery capacity utilized (C) is not statistically significant in equation (1), it has the expected negative sign indicating that for given output (Q), an increase in utilization of fixed machinery reduces total costs. Total cost function (1) is converted to an average cost basis (total cost per dollar of total revenue) and compared graphically with alternative cost functions later. Results from equations employing alternative functional forms also are briefly mentioned later.

Cost curves derived indirectly from a production function. An adjustment for the "regression fallacy" problem, even if successful, accounts for only one factor causing farms to lie "off" the envelope surface. In addition, sampled farms may be operating with nonoptimum resource combinations because of lack of information, inadequate managerial ability, tenure situation, and related reasons. The following analysis attempts to adjust for both of these sources of inefficiency by first estimating the production surface, then deriving the expansion line combinations of inputs as a basis for estimating short-run cost curves.[15]

Specifically, a second regression model—equation (2)—is formulated relating output to four major input categories and the machinery capacity variable.

$$(2)\qquad Y = .2995R^{\overset{(3.01)}{.2289}}L^{\overset{(6.23)}{.4524}}E^{\overset{(4.28)}{.4048}}M^{\overset{(.24)}{.0253}}C^{\overset{(1.27)}{.0762}} \qquad R^2 = .95,\ N = 37$$

Y = annual farm output (total revenue based on average prices, in dollars).
R = real estate in total crop land (acres).
L = total annual farm labor, including all hired, family, and operator labor (dollars).
E = annual productive cash expenses (excluding taxes, insurance premiums, and interest payments).
M = market value of machinery investment (dollars).
C = percentage of available machinery capacity utilized.
t-values are given in parentheses.

Cost curves based on production function (2) were obtained as follows: Sub-production functions were derived for each of the four size (acre) groups with (1) the machinery variable held constant at the arithmetic mean (for the respective group) and (2) machinery capacity (C) set at 100 (maximum utilization). Other resources (land, labor, and productive expenses) were then combined in optimum (expansion line) proportions.[16]

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[15] Even with these adjustments, technological inefficiencies may remain.

[16] Briefly, the mathematical derivation of the optimum (expansion line) input combination for each level of output includes (a) equating marginal rates of substitution $\frac{\partial R}{\partial L}$ and $\frac{\partial L}{\partial E}$ with their respective price ratios, then (b) solving simultaneously the resulting two equations and the basic production equation (2).

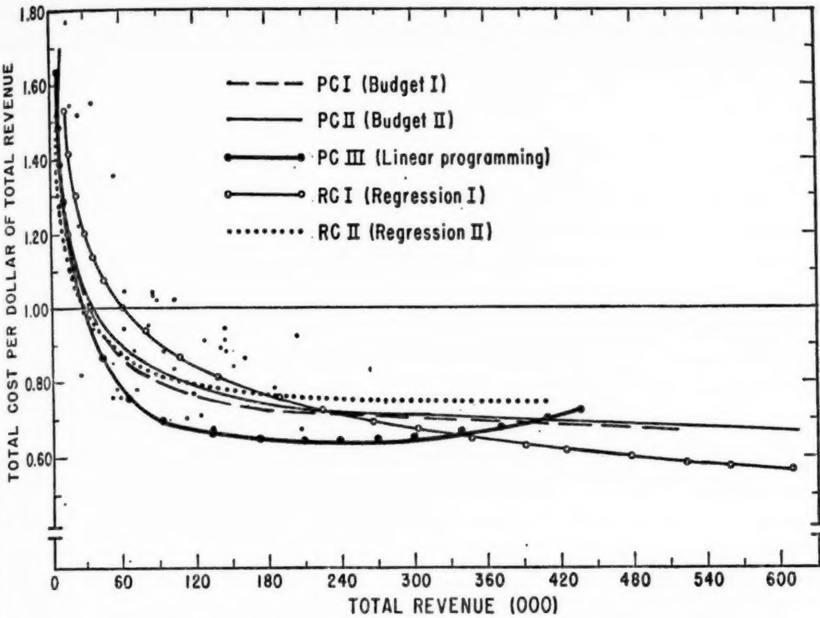

Fig. 4. Comparison of planning curves derived by budgeting, linear programming, and regression methods.

Short-run cost functions based on these expansion line input combinations and associated output levels were then derived.[17] An envelope curve to these short-run curves was determined graphically and is presented in Figure 4 for comparison with cost curves derived by alternative methods.

Summary and comparison of alternative cost functions

Five alternative cost functions derived in this study are graphically summarized in Figure 4; plotted points represent the 37 individual farm observations. These cost functions suggest three alternative conclusions: (1) substantial economies throughout the range of output (RC I), or (2) substantial economies up to $100,000-$150,000 of output with only slight economies thereafter (PC I, PC II, and RC II) or (3) substantial economies to about $120,000 output, further slight economies to $240,000 and slight diseconomies thereafter (PC III). This inconsistency can be traced directly to underlying assumptions and methods, emphasizing the importance of selecting methodological procedures appropriate to the research question of interest.

[17] To allow comparison with the earlier budgeted curves, output figures were adjusted to a rental-share basis. Variable costs associated with each output level were computed directly from the labor and productive expense variables. Fixed machinery costs were based on machinery combinations from the sample data; land changes were not made since total revenue was adjusted to a rental-share basis.

The primary question in this study is: What are the relationships of cost to output as farmers expand operations in an *efficient* manner, consistent with *realistic restrictions* facing them? For this question, the authors place least confidence in the regression equation fitted directly to cost observations (RC I). In the low output range, RC I lies considerably above all other curves as well as above many actual farm observations. An attempt to "shift" this curve downward, with the machinery capacity variable, emphasized that other factors such as inefficient technology, inefficient input combinations, risk considerations, and managerial capacity are important in causing some farms to operate above minimum cost positions.[18] The second regression model (RC II)—formulated to allow both for full machinery utilization and optimum input combinations—provides a cost curve more consistent with the budgeted cost curves. However, neither regression model included adjustments for the problem of varying multiple product mixes or technological inefficiency. Because the empirical data represent varying product mixes, the product trace followed on the total cost surface is unclear in the regression analysis.[19]

The Budget I analysis (PC I), while providing an envelope curve almost identical with that based on Budget II (PC II), is based on the unrealistic assumption of a constant product-mix for all farm sizes. Thus, given the question posed above, the authors place greatest confidence in the Budget II (PC II) and Linear Programming (PC III) analyses. The latter has a conceptual advantage because it is based on *optimum* rather than *typical* cropping systems at each output level. Thus, the programmed cost curve falls below the Budget II cost curve over the relevant output range. Also, the programming curve (PC III) forms an approximate envelope curve to the actual farm observations; only four farms—each with a cropping system not feasible within long-run rotation restrictions—fall below the PC III curve. Unfortunately, no farm observations beyond \$360,000 are available. The lack of observations in the high output range

[18] Also, the regression curve is quite volatile, depending importantly on the functional forms and the deletion or inclusion of a single "questionable" farm observation. Several different functional forms were fitted to the same data. In one case a quadratic curve had a U-shape; deletion of a questionable observation changed the regression curve substantially. More data in the high output range would undoubtedly improve the reliability of regression analysis; unfortunately, lack of enough large-farm observations is almost always a problem.

[19] However, this approach may be more useful where the product is homogeneous (i.e., for single product or fixed multiple product firms). Attempts have been made elsewhere to deal with multiple product firms with independent production functions and with simultaneous equations. Aside from certain methodological problems, data requirements to implement such models are substantial. See: French, Burton L. "Simultaneous Economic Relationships and Derivation of the Production Function," and Beringer, Christoph, "Problems in Finding a Method to Estimate Marginal Value Productivities for Input and Investment Categories on Multiple-Enterprise Farms," Chaps. 10 and 11 in *Resource Productivity, Returns to Scale, and Farm Size, op. cit.*

suggests that perhaps RC II and PC III may be quite realistic; i.e., showing no great economies (even diseconomies in PC III) with further expansion.

The Budget II and Linear Programming analyses clearly indicate that cost economies are one reason for the present trend toward consolidation and expansion in size of smaller units in Yolo County. On the other hand, the analyses do not indicate a strong economic incentive for expansion to extremely large size; farms of about 750-900 acres appear able to compete on a unit cost basis with much larger farms. Yet because unit costs are approximately constant over a wide range, a continuation of a wide variation in farm sizes can be expected, with little tendency for farm size to concentrate at a single "optimum" size. In the absence of diseconomies, the primary factors responsible for size differences will probably be managerial ability, capital supply, and risk and uncertainty.

The Yolo County area appears to be sufficiently representative of many other irrigated field crop areas of California and elsewhere in the West (in terms of types of crops, size of machinery and equipment, etc.), to suggest a similar pattern of cost relationships.[20] From a policy standpoint, the results clearly indicate the economic inefficiency associated with development programs limiting farm size in similar agricultural areas to 160 or 320 acres. If such size limitations appear desirable on social and other grounds, the sacrifice in efficiency should be clearly recognized.

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[20] Of course, cost relationships for farms raising fruits, nuts, vegetables, and other specialty crops undoubtedly are far different. Companion cost studies of important fruit and vegetable areas in California are now underway.

NOTES

SUPPLY CONTROLS AND ACREAGE CONTROLS: A PROPOSED SYNTHESIS*

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*Texas A. & M. College***

FOR more than three decades there has been a continuing serious search for an economically sound, socially and politically acceptable, national agricultural program for the United States. Agriculture, buffeted by the impact of wars and an unstable industrial economy on the one hand and a rapidly moving technological revolution on the other, repeatedly has found it necessary to call upon the federal government for assistance in weathering the relentless onslaught of economic cross-currents. The resultant erratic demand for farm products together with the ever increasing excess productive capacity of our farm resources, though held somewhat in abeyance by present farm programs, continues to threaten near economic and social havoc to those engaged in farming for a livelihood. Furthermore, increasing fixed costs, inherent in the rapidly advancing agricultural technology, make agriculture's economic position increasingly, rather than less, vulnerable as time goes on.

The continuing unsavory commodity surpluses, storage problems and government outlays associated with agricultural programs post war have led several agricultural economists to a consideration of supply controls as a possible alternative.[1] Yet supply controls, like acreage controls, have serious weaknesses. The objective in this paper is to introduce for discussion the possibilities of a synthesis between a system of supply controls and the present acreage controls. The synthesis, formulated by the author, suggested itself as a possible means of overcoming the obvious inherent weaknesses in various previous proposals, including supply controls.

Weaknesses of Previous Proposals

It is the consensus that the major problem in a system of supply controls lies within the area of feed grains, livestock and livestock products. Cochrane, a major proponent, has suggested, for example, that direct application to feed grains is impracticable since livestock too often are fed on farms producing their own grain supply. As an alternative, he proposes direct supply controls on livestock and livestock products.[2]

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* Texas Agricultural Experiment Station Technical Article 3622.

** The views expressed in this technical paper represent those of the author and not those of the Agricultural and Mechanical College of Texas.

[1] Cochrane, Willard W., "Some Further Reflections on Supply Control," *J. Farm Econ.*, 41:697-717, Nov. 1959.

[2] *Ibid.*, p. 713.

Several cogent reasons make the latter proposal one that should be avoided at almost all costs. First, livestock producers have traditionally vehemently opposed any and all forms of controls. Direct price controls on livestock, it may be remembered, were soundly defeated during the emergencies of World War II. Can we truthfully conclude that livestock producers are any more docile now? Hardly. Secondly, the need for an agricultural program evolves from the more basic problem of land utilization—not one of livestock production. Fortunately for the nation's long run interest, agricultural land is in excess supply over current effective demand needs, in the setting of present technology and population. And livestock production, in which inputs can be readily shifted to utilize a large or small land area, lacks a firmness of control over the central problem. As Brandow has pointed out, the result of livestock supply controls likely would be only to overload the non-feed grain markets.[3] Thirdly, livestock represents one of the more fluid elements in agriculture today as each geographic region seeks more balance between production and consumption. Furthermore, considerable difficulty would be encountered, to say the least, in coping with the steady and desirable increase in livestock and feeding, both cattle and poultry, throughout the South, Southwest and West. To freeze the present livestock production pattern would be not only uneconomic but a disastrous block to desirable agricultural production adjustments—both national and regional.

Intricate problems also would develop as to the proper level for livestock control application. What about, to mention one, the level of cattle weights? Control over the number of head would be analogous to, and have the same limitations as, efforts to control crop production via acreage alone. Furthermore, as Brandow notes, livestock production generally has shown the capacity to adjust to market demand—a feature uncharacteristic of crop production.[4] Why burden ourselves, therefore, with controls over one of the few major segments of agriculture that shows the capacity to reasonably well balance itself? Agricultural economists can hardly expect to be commended for that type of recommendation. In reviewing supply and acreage controls, Brandow surmises that the use of supply controls on all crops other than feed grains and a continuation of acreage controls on feed grains may be a plausible means of avoiding Pandora's box.[5] Recognition thus is given to the objectionable features of livestock supply controls already mentioned. Unfortunately, however, history has already proven that acreage controls for feed grains would only perpetuate the difficulty now experienced—oversupply at desirable price levels. Certainly more aggressive limits to acreage allotments would be required than have been applied

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[3] Brandow, G. E., "Supply Control: Ideas, Implications and Measures," *J. Farm Econ.*, 42:1167-80, Dec. 1960 (see p. 1173).

[4] *Ibid.*, p. 1178.

[5] *Ibid.*, p. 1173.

in the past. But is this not the same old barnyard game of the dog chasing its tail? Recognition must be given to the basic fact that technology is not fixed. Nailing down the launching pad (acres), as we have already witnessed, does not keep the rocket (production) from sailing into space—rather it gives it an important assist. And, according to the U. S. Department of Agriculture, most producers are still below the economic optima of fertilizer use wherein marginal costs equate marginal returns.[6] In short, the mixture of approaches Brandow suggests represents a somewhat defensive retreat which is indicative of the generally anemic contribution in this area by our profession in recent years.

The open-endedness of acreage controls led Cochrane, earlier, to wonder, though not seriously, if we may even need some form of capital rationing.[7] Were it not that it would thwart applied technological advances needed for future well being, direct control over fertilizer purchases would probably be more effective than livestock controls.

Requisites of a National Agricultural Program

Goals for an acceptable farm program for the United States have been reasonably well stated by Halcrow.[8] They are to (1) stabilize agricultural income, (2) increase agricultural income in keeping with gains in other sectors of the economy, (3) increase production efficiency in agriculture, and (4) contribute to the general welfare of the economy.

Many proposals have met objective one, but run contrary, in varying degrees, to the other three. With the above guides in mind, the following proposal is suggested.

Needless to say, continued federal administrative guidance of agriculture is involved. The U. S. Congress has repeatedly taken the position that this is in the interest of the general welfare of the national economy—objective four stated above.

A Supply-Acreage Control Synthesis

The basic components of the following proposal are not new. To my knowledge, at least, the proposed synthesis is. Just as the Marshallian synthesis of the two propositions that (1) cost of production (supply) alone controlled price and (2) that demand alone determined price opened the way out of an impasse, perhaps the synthesization suggested here can lead interested agricultural economists to some new program formulations.

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[6] *Ibid.*, p. 1178, and ref. cit.: D. B. Ibach and R. C. Lindberg, *The Economic Position of Fertilizer Used in the United States*, Agr. Info. Bul. No. 202, U.S. Dept. Agr., Nov. 1958.

[7] Cochrane, W. W., "A Balanced Farm Program for Agriculture," Texas A. & M. Grad. School Lecture Ser., Apr. 14, 1959.

[8] Halcrow, H. G., *Agricultural Policy of the United States*, Prentice-Hall, Englewood Cliffs, N.J., 1953.

The synthesis is a combination of acreage controls and supply controls. Either alone has serious inherent defects. Combined, some hybrid vigor may be achieved.

Only the broader aspects of a synthesis acreage-supply control program are outlined here. Breaking of national programs down to the farm level usually is where failure is encountered. Therefore, weaknesses particularly must be searched for at that juncture. The program would apply to the now designated "basic crops" and be extended to all others where needed.

The initial step at the national level would be to estimate national supply requirements for the basic field crops. Hay and forage crops would be excluded since they are inputs for livestock production, which would remain uncontrolled. Prices used in ascertaining national supply requirements that would clear the market could be tied to present parity concepts or any other politically acceptable basis. The next step would be to allocate the supply to state and county units.

The supply requirements, or quota, for the nation would take into account, besides civilian demand at the prescribed parity price level, military and export needs and desired reserve stocks. It is suggested too that it would be desirable to systematically work off present surpluses, over a reasonable period of years, thus eventually eliminating the present government storage costs. Economists within the U. S. Department of Agriculture or a farm board comparable to the Federal Reserve Board would be capable of adequately determining supply requirements with reasonable accuracy.

The price support program would be abolished, and government storage programs would be abandoned, allowing a reasonable time for orderly liquidation of existing stocks. The annual supply quota would clear the market at a price determined by demand in the competitive market place; it likely would be either somewhat higher or lower than predicted, but over time should balance out to the desired parity level. Some degree of price freedom is the necessary cost of getting out of costly government price support and storage operations.

The third major step in the application of the synthesis supply-acreage control program is at the farm level. Individual farms would receive supply quotas which also would be converted into acreage allotments based upon their own historical average yields, preferably for the past ten years in order to have a relatively stable average. Calculation and analyses of coefficients of yield variation could be used nationally or locally in setting criteria for the selection of the proper base period length. Each farm thus would receive a dual allotment—one of acreage and the other in total product units. The farm's supply quota could be either consumed on the farm or marketed. Marketing certificates would be issued in the amount of the supply quotas. Sales would be prohibited outside of the certificated

amounts and violations by both seller and buyer subjected to heavy cash penalties on each.

The farm-level functioning of the program can be more clearly illustrated by introducing time dynamics. Assume that a given midwest farm has an initial supply quota of 3,000 bushels of corn and 60 acres of corn allotment derived from the farm's past ten-year average of 50 bushels yield per acre. Two possibilities are most likely—overproduction or underproduction of the quota. If overproduction results in a total crop of 3,500 bushels on the 60 acres, 500 bushels would be placed off the farm in officially approved commercial storage facilities, at the farmer's, not the government's, expense, and duly accounted for by warehouse receipts. Failure to place the product in required storage would be subject to heavy penalties. If corn were produced for silage, or use as other than harvested grain, a sufficient number of bushels would have to be harvested as ear corn to meet oversupply quota storage requirements.

Yields of corn and similar crops consumed, all or in part, on the farm could be determined by scientific sampling methods, now available or which can be developed, thus eliminating the necessity of harvesting at any particular time or in any particular form for feeding use.[9] At the end of the supply quota year, the farm would be inspected as to the stock of corn remaining and certificates would be surrendered for the balance fed, as though the producer in effect had purchased the corn from himself for feed use. This presents no obstacle since it is directly comparable to intercompany transfers in corporate business management. Authenticated sales records would be required of all corn sold, with which, of course, properly endorsed certificates would have been released. Furthermore, it would be mandatory that all grain sales from the farm be reported within five days to the county agricultural office as to date and to whom sold, again with heavy penalties for default. Concealment of production would work to a disadvantage for the farm allotment, as shall be seen shortly.

The following year, assuming a five percent increase in national supply requirements, the farm would have a basic supply quota of 3150 bushels and a 63 acre acreage allotment. Deducting the 500 bushel overproduction of the preceding year, which has been kept in storage, the net supply quota is 2,650 bushels. Fertilizer or other inputs can be reduced and the net quota grown from the base 63 acres, or previous production practices can be maintained and only 53 acres used, whichever is preferred by the producer.

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[9] Staff report of Dr. Walter A. Hendricks, Research Statistician of the U.S.D.A. Crop Reporting Board, upon return from a post-World War II personal study of crop estimating methods in Germany. The author was a statistician with the Agricultural Price Statistics Branch during that period, 1947-1951. Hendricks reported that German methods of field sampling and estimating of grain yields were decidedly superior to the United States system.

TABLE 1. HYPOTHETICAL PRODUCTION AVERAGE FOR A FARM EXPERIENCING A POOR CROP YEAR IN THE FIRST YEAR OF SUPPLY-ACREAGE CONTROLS

Year	Base	Program Operation Year			
		1	2	3	4
1951	2500				
1952	3200	3200			
1953	3200	3200	3200		
1954	3000	3000	3000	3000	
1955	2700	2700	2700	2700	2700
1956	3500	3500	3500	3500	3500
1957	3300	3300	3300	3300	3300
1958	2600	2600	2600	2600	2600
1959	2900	2900	2900	2900	2900
1960	3100	3100	3100	3100	3100
1961		2000	2000	2000	2000
1962			3400	3400	3400
1963				3500	3500
1964					3000
10 year average	3000	2950	2970	3000	3000

The opposite experience—underproduction of the supply quota—presents the following situation. If 2,500 bushels were produced compared to a quota of 3,000, certificates for the deficit 500 would not be used.[10] The latter would be redeemed at the county agricultural office at the end of the quota year and re-issued in the form of new current certificates the following year.[11] In the second year, a supply quota of 3,150 bushels would be allocated, assuming again a three percent increase in the national quota. The net supply allotment would be 3,650 bushels, and a temporary increase to 68 acres over the basic 63 acres acreage allotment would be granted. Thus, the producer would have to seek above-average yields per acre that year in order to use his full reserve of marketing certificates.[12] Incentive for technological progress would thus be maintained, which is in line with the third stated objective of a desirable national agricultural program.

Two functions are served by not allowing a pro rata increase in the basic acreage allotment following a short crop year. Supplies will be kept nearer to normal by the likelihood that two to three years may be required to retrieve the loss.[13] Note the effects of low and high yields, as illustrated in

[10] I prefer the non-negotiable certificate although it is not a mandatory part of a synthesis supply-acreage control program.

[11] Certificates would also be re-issued for any unsold quota stocks carried over. Stocks on farms are regularly reported by the U. S. Crop Reporting Board and these would be taken into consideration in setting supply quotas for the new crop year.

[12] Increased temporary acreage allotments could be established if short-run conditions demand it. Here, half the necessary increased acreage, with average yields, is given to assist in regaining the loss from a poor crop year.

[13] In a free agricultural economy this would likely be true anyway. Short crops are not necessarily immediately followed by bumper ones.

TABLE 2. HYPOTHETICAL PRODUCTION AVERAGE FOR A FARM EXPERIENCING A GOOD CROP YEAR IN THE FIRST YEAR OF SUPPLY-ACREAGE CONTROLS

Year	Base	Program Operation Year			
		1	2	3	4
1951	2500				
1952	3200	3200			
1953	3200	3200	3200		
1954	3000	3000	3000	3000	
1955	2700	2700	2700	2700	2700
1956	3500	3500	3500	3500	3500
1957	3300	3300	3300	3300	3300
1958	2600	2600	2600	2600	2600
1959	2900	2900	2900	2900	2900
1960	3100	3100	3100	3100	3100
1961		3500	3500	3500	3500
1962			2650	2650	2650
1963				3500	3500
1964					2000
10 year average	3000	3100	3045	3075	2975

tables 1 and 2, on the level of the farm supply quota—ten year average production. A wide range of yields has been assumed, representing a coefficient of variation of about 14 percent. Furthermore, the producer may wish to hold some portion of his extra certificates in reserve as a hedge against overproducing his quota. It should be noted that supply certificates under the program are not considered to be negotiable. To prevent a build up of a reserve of extra certificates, it probably would be desirable to cancel any quota certificates re-issued for as many as three years.

Agricultural technological progress could be fostered in another way through the supply-acreage control program. Allocation of county-level supply quotas could be tied by several means to historical production-yield averages. Thus, the more progressive producers with higher output per acre would share a gradually larger part of the county allotment over time. Less productive land could be systematically retired to other utilizations as acreage allotments declined over time. Minimum size acreage allotments could be used as a lower limit. Also, some shifting of allocations among counties and states could be made automatically by the same or a similar technique. Thus, the production location of a commodity would not be totally frozen—an unwelcome attribute of most control mechanisms.

Penalties for illegal sale or use of feed grains, or other controlled commodities, must be severe. Fines should be monetary on both buyer and seller but might also have attached the cancelling of supply certificates to the seller for as much as a three-year period. Fines should be payable directly to the U. S. Treasury or earmarked for special purposes, such as Section 32 funds.

Another flexible feature, among many, that could be coordinated with

the program, would be a separate group of supply-acreage quotas and certificates for export crops. Effective two-price systems could thus be formulated without the costly leakage or export subsidy difficulties of other modus operandi. Such a device could also be combined with a "food for freedom" national or international effort.

In summary it appears that a program of synthesized supply and acreage controls probably could assist materially to (1) hold production to desired levels over the short and long run, (2) keep production from year to year within reasonable limits, (3) shift storage costs of surpluses back to the producer where they belong, (4) stabilize agricultural income by having an administered market supply—a system long used by most major manufacturing industries in our "free enterprise" system, (5) return prices to a free market determination, within the framework of administered supply control, (6) provide a continued incentive for progress in production technology on the farm, (7) permit production, over time, to shift toward the more efficient producers rather than tending to freeze allotment patterns as in the past, and (8) retain livestock and livestock products production and prices in a free market determination framework.[14]

While the program outlined above no doubt has its share of imperfections and costs, there is no way out of the present enigmatic situation without having some concurrent costs attached. Also, some avenues for further useful agricultural policy formulation by our profession are suggested and they are sorely needed.

The need for brevity prevents giving a more detailed working model here, or mentioning various other flexibilities that might be incorporated into such a program. As John D. Black once so wisely remarked, no control program should be without re-evaluating correction mechanisms, be it a local area milk marketing order program or a national effort.

[14] It is recognized that milk marketing orders and many other types of controls do now and will continue to exist.

JAPANESE AGRICULTURE: PRODUCTIVITY TREND AND DEVELOPMENT OF TECHNIQUE

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1. Clues to the Development of Japanese Agriculture

THE development of productivity achieved by Japanese agriculture in the pre-war period was quite striking in comparison with trends in the same field in the advanced countries, and it played an important

[*] The work of putting this paper into English was supported by the Ford Foundation as a part of projects for promoting translation of Japanese economic articles.

role in accomplishing an astonishingly high rate of growth in the Japanese economy as a whole. From the Meiji Revolution (1868) onwards, in the first stage of economic development the rent created by agriculture constituted the main source for the accumulation of capital, the land tax being the only financial resource for the Meiji Government: in the period from 1886 to 1892 this tax accounted for 58 per cent of total internal revenue.[1] For the less advanced nations, it may be natural that in their first stage of development agriculture is made responsible for the accumulation of capital. It is doubtful, however, whether the accumulation of capital at this high rate would have ever been possible for Japan, if there had been no such development in agricultural productivity. In the Japanese economy, where, contrary to what happened in other less advanced countries, foreign capital was not introduced, agricultural development was an initial stimulant for development in general. In considering the high rate of growth of the Japanese economy, therefore, we must first examine what made the development of agricultural productivity possible.

The rate of growth in Japanese agriculture, measured by agricultural income, in real terms, reached about 2.0 per cent per annum through the 60 years from 1880 to 1940. As the manifestation of a long-term trend, this figure should be regarded as quite high in comparison with corresponding figures for the advanced countries. If measured in terms of the development of the agricultural production index, the rather rapid rate of growth in the early stages gradually slackened (see Chart 1). Why did the rate of development slow down in this way? Was it due to the decreased inflow of capital and labor into agriculture? Or did the law of diminishing returns begin to function in agricultural production? In order to consider the productivity trend of Japanese agriculture, we must consider the long-term trend of the production factors in the industry.

2. *Factors of Development in Japanese Agriculture*

In this article, the production factors in agriculture will be discussed in four categories: land, labor, fixed capital and operating capital. As for the agricultural production index and the cultivated area, sufficient data for us to assess their long-term trend are readily obtainable. With regard to the labor force, too, certain data, although based on estimates to some extent, enable us to obtain analogous figures. In the case of capital, however, there are no data available enabling us to assess its trend over the whole of the period under consideration. For this reason, the total volume of energy functioning in agriculture will be regarded as representing the fixed capital—in other words, the total number of horses, cattle, motors, engines, etc., all expressed in terms of horse power. Needless to say, the

[1] Tohata, Ohkawa, *Nihon no Keizai to Nōgyō* (Japanese Economy and Agriculture), Iwanami, 1956, Vol. 1., p. 379.

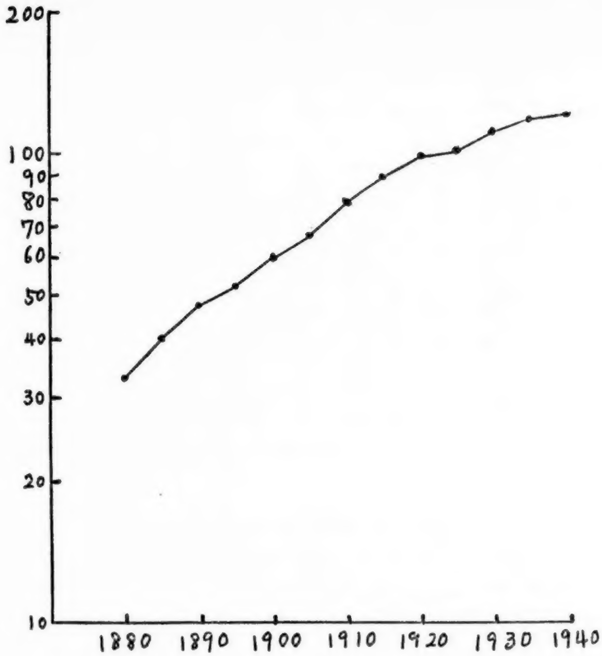

CHART 1. TREND OF AGRICULTURAL PRODUCTION (1921-25 = 100).

term "fixed capital" in agriculture includes manually operated farm machinery, farm buildings, etc., in addition to the above. However, the equipment capable of generating non-human energy is assumed for purposes of this analysis to represent those assets related to productivity. Operating capital will be represented by fertilizers, since they are the chief factor of this kind in Japanese agriculture. Because many different kinds of fertilizer have been used, a consolidated figure has been obtained by dividing the value of fertilizer input by the fertilizer price index.[2]

It should be borne in mind that the above production factors, with the exception of the operating capital, all correspond to the conception of "stock." For example, by the labor force we mean the number of workers engaged in agriculture, not the number of man hours involved in actual agricultural production. The latter would be the former multiplied by the average working hours for the year. Likewise, in order to determine what part of the total energy actually participated in production, it would be multiplied by the rate of operation. However, the question to be discussed here relates to the efficiency for stock but not for flow, implying that any change in the rate of operation should be regarded as the result of technological progress.

[2] Fuller description of the data used and their sources is given in an appendix at the end of this paper.

TABLE 1. TRENDS OF INPUT IN JAPANESE AGRICULTURE

Year	Labor (1,000)	Cultivated area (1,000 cho-bu[a])	Fertilizer input index (1933–37 = 100)	Total Energy (1,000 HP)	Production index (1921–25 = 100)
1878–1882	14,787	4,690	0.863	1,036	33.1
1883–1887	14,780	4,758	0.945	1,008	39.7
1888–1892	14,700	5,130	1.48	988	47.1
1893–1897	14,580	5,237	2.07	1,034	52.2
1898–1902	14,450	5,260	5.16	1,081	60.7
1903–1907	14,355	5,427	12.9	1,058	67.2
1908–1912	14,317	5,708	24.1	1,168	78.2
1913–1917	14,309	5,926	34.5	1,234	89.2
1918–1922	14,235	6,138	50.0	1,357	98.3
1923–1927	14,102	6,078	68.4	1,417	103.1
1928–1932	14,191	5,968	88.6	1,564	112.3
1933–1937	14,413	6,061	100.0	1,758	119.5
1938–1942	14,358	6,083	136.5	2,140	121.3

[a] 1 cho-bu∼1 hectare.

Table 1 and Chart 2 indicate the input of the above-mentioned production factors into agriculture on a basis of average figures for each five-year period since 1878. From a long-term point of view, the cultivated area has increased only slightly and the increased volume of production was achieved by the increase in input of fertilizer and in fixed capital. The labor force, too, has undergone almost no change, or rather has slightly decreased; probably an indication that in the early stage agriculture was employing a surplus labor force.

The table suggests some further conclusions. Since cultivated land is restricted in Japan, agriculture has been conducted with the aim of achieving land-intensive farming by an abundant investment of capital, thereby increasing the land productivity of a given area of land. Such land-intensive farming made it necessary to introduce labor-intensive farming at the same time, which was done by raising the degree of utilization of labor and substituting other sources of energy for it. The rate of planting may be estimated to have increased by about 30 per cent during 60 years, indicating that the operation rate of land has increased that much, and the land productivity was also raised accordingly. The substitution of bought for home-produced fertilizer is also an indication that the labor previously engaged in making the latter was now set free to participate in farming directly.

In other words, the increase in the ratio of output to input of production factors in agriculture, which will be discussed below, may be a net result of two related factors, namely, the increased operation rate of production factors on the one hand, and the increased efficiency obtained through the change in the combination of inputs on the other.

The increased input of purchased fertilizer made it possible to increase the rate of planting and minimize the use of home-produced fertilizer.

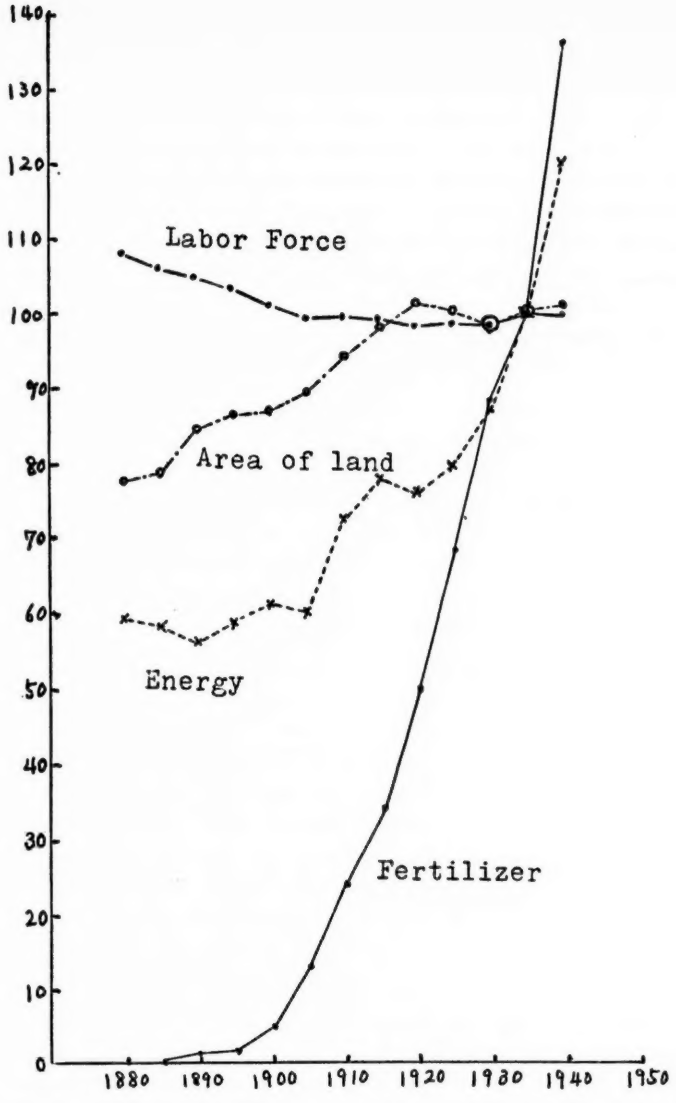

CHART 2. TRENDS OF INPUT IN JAPANESE AGRICULTURE (1933-37 = 100).

However, such an abundant input of fertilizer could never have been realized if there had been no shift to the fertilizer-consuming rich-harvest kinds of crop. It is true that the cattle previously bred with a view solely to their production of manure were now utilized in cultivating, and also that the engines whose only use had been in threshing were now serving cultivation, both of which factors resulted in increased capital efficiency of assets. However, the above changes were made possible only when a cultiva-

tion technique making use of cattle and horses had spread and cultivators had been developed. Further, the principal reason for the increased rate of planting was the growing of wheat and barley as a second crop in the rice-field, and there is no doubt that the process was accelerated by installation of drainage pumps. As a matter of fact, the increased operation rate of production factors and the raised efficiency of capital were able to exert their full effect only when the improved kinds of crops were made available, a cultivation technique making use of horses and cattle had become widespread, and pumps and engines had been developed or improved.

TABLE 2. CHANGES IN FACTOR COSTS AND IN PRICES OF RICE IN JAPANESE AGRICULTURE

	1878–87 average	1903–12 average	1923–32 average
Rent[a]	100	288	621
Wage-rate	100	216	850
Price of fertilizer[b]	100	256	322
Capital cost[c]	100	78	95
Price of rice[d]	100	209	431

[a] Rent of paddy field.
[b] See Appendix.
[c] Index of steel price times index of interest rate.
[d] Because rice is the leading agricultural product in Japan, changes in its price are considered typical of those of agricultural products generally over extended periods.

As for the phenomenon of an increase in production without any increase in the employed labor force, this was made possible by an increase in the degree of utilization of labor; the operation rate, that is, was raised. However, a rather greater part was played in this connection by the substitution of other production factors for labor. It is the relative price of factors that determine the substitution of production factors from one another In Japanese agriculture, as seen from Table 2, which gives a long-term comparison of production factors with one another, the price of labor showed a relative rise, while that of fertilizer remained relatively low.

The increased producing power was the combined effect of the following three processes: an increase of inputs; a changed combination of production factors into a more favorable one, resulting in increased efficiency of production; and an increased operation rate for the production factors in agriculture. Such increase in production efficiency and rise in operation rate were only possible through technological progress.

3. *Measurement of Technological Progress*

As mentioned above, the development of Japanese agriculture was made possible, to a large extent, by capital investment. However, technological progress has played an even greater part in raising productivity. In fact, as far as agriculture up to 1920 is concerned, much of the funds accumu-

lated through agriculture (including rent) were not reinvested in it, but flowed out of it, constituting thereby an accumulation of capital for other industries. On the other hand, however, the role which the other industries as well as the government played in the technological progress of agriculture should not be underestimated. Of that portion of income which was taken away from agriculture, some was returned to agriculture in the form of technical progress. Especially in Japan, where improvement of crop varieties was carried out chiefly by the government research institutes, this contributed much to agricultural development in its early stages. Further, the development of the ammonium sulphate industry provided low-priced fertilizer, and the progress in the mechanical engineering industry accelerated the development of pumps and engines.

In order to examine how much such technical progress has contributed to the rise in agricultural productivity in the United States, an attempt was made by T. W. Schultz[3] to conduct a comparison of real cost, a procedure for approximate measurement of technical progress, although there have been some procedures devised for the same purpose which make use of production functions. Schultz's procedure consists of the comparison of the cost per unit product required for the base year with the same required for the year concerned, providing price fluctuations are excluded, and the gap between both figures is regarded as the result of technological development. It can be formularized as follows:

The unit cost for the year concerned (π_1) is

$$\pi_1 = \frac{N_1W_0 + L_1r_0 + C_{11}P_0 + C_{21}p_0}{Q_1}$$

and the unit cost for the base year (π_0) is

$$\pi_0 = \frac{N_0W_0 + L_0r_0 + C_{10}P_0 + C_{20}p_0}{Q_0},$$

wherein

W_0 = wage rate
r_0 = rate of rent
P_0 = interest rate + depreciation rate
p_0 = value of circulating assets.

The average for the years 1934-36 was taken as the base year, since the cost composition is known for these years. Next, a consolidated cost index was worked out (see Table 3), using the base period cost composition for weighting. The ratio of this index and the production index is the index of unit real cost. It shows a remarkable decrease from 2.82 in 1882 to 1.00 in

[3] T. W. Schultz, *The Economic Organization of Agriculture*, New York: McGraw Hill, 1953, p. 102.

1935. This means that since 1880 the development of agricultural technique has reduced the unit cost of agriculture to about one third.

However, it is also clear that the increase of productivity due to technical progress has not proceeded evenly but has gradually slackened. Only up to 1900 or so was technical development striking, and after 1910 the increase in productivity due to technical progress became very slow.

In this connection, it should be pointed out that government aid of Japanese agriculture continued only up to 1910, and that after World War I the emphasis in regard to increased food production was shifted to the colonies (Formosa and Korea) and in Japan proper efforts for the increased productivity of agriculture were neglected. The comparison of production indices, in Chart 3, indicates how steeply production increased in the colonies after 1900. There is no doubt that the activity in improving crop varieties and mechanization leveled off during approximately the said period.

TABLE 3. TREND OF UNIT COST INDEX (1933–37=100)

Period	Cost index	Real unit cost of agriculture
1878–1882	78.1	2.82
1883–1887	78.2	2.36
1888–1892	79.5	2.02
1893–1897	79.8	1.83
1898–1902	80.1	1.58
1903–1907	82.3	1.46
1908–1912	84.5	1.29
1913–1917	87.3	1.17
1918–1922	90.6	1.10
1923–1927	92.8	1.07
1928–1932	96.2	1.02
1933–1937	100.0	1.00
1938–1942	107.3	1.06

Chart 4 presents an extreme contrast to the situation in the U. S. A., where rapid technical progress was taking place about the same period, as is evidenced, for example, by the spread of hybrid corn and the development of tractors, which resulted in a sharp increase of productivity. After World War II, however, the need for increased food production became acute in Japan proper owing to the loss of colonies. Productivity in general increased remarkably as a result of the spread of agricultural chemicals and progress in nursery technique, and the tempo of technical progress seems to have resumed its upward move.

The above analysis has proved that the tempo of increase of productivity in Japanese agriculture has depended very much upon technical progress. It may well be assumed that the same will be true for the future. It must be borne in mind that at least in the early stage of development of Japa-

nese agriculture the rise in productivity was due to the rise of the technical level within agriculture and also to the repercussion of industrial progress on agriculture.

Appendix: Sources of Data and Estimates Used

The figures of cost composition have been calculated from "the expenditures of farm families on agricultural enterprises," taking the average figures for the years 1934-36 as clarified by the Farm Household Economic Surveys.

The land cost including rent is based on the figures corresponding to the estimated total rent which would have been raised if all cultivated lands had been tenant-land.

The cost for fixed capital consists of the value of agricultural assets excluding land, but including estimated interest of 4 per cent and estimated depreciation of 4 per cent.

The operating capital is the total of the expenses for fertilizers, lighting,

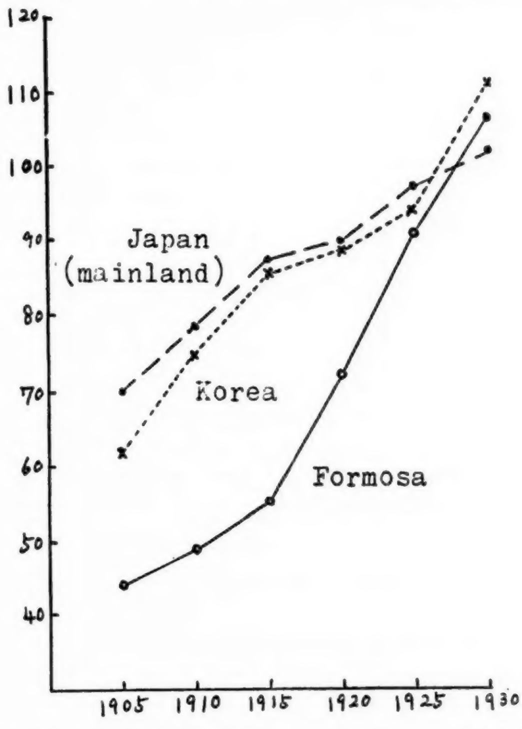

CHART 3. TRENDS OF AGRICULTURAL PRODUCTION IN THE COLONIES (1932-34 = 100).[1]
Source: Isamu Yamada, *Tōa Nōgyō Seisanshisū no Kenkyū* (A Study of Far-Eastern Agricultural Production Indexes), Nihonhyōron, 1942.

[1] The index here for mainland Japan is the same as that mentioned in Table 1 and Chart 1. However, the base period is different. In Chart 1, the semi-logarithm scale is used, and here the ordinary graph is used.

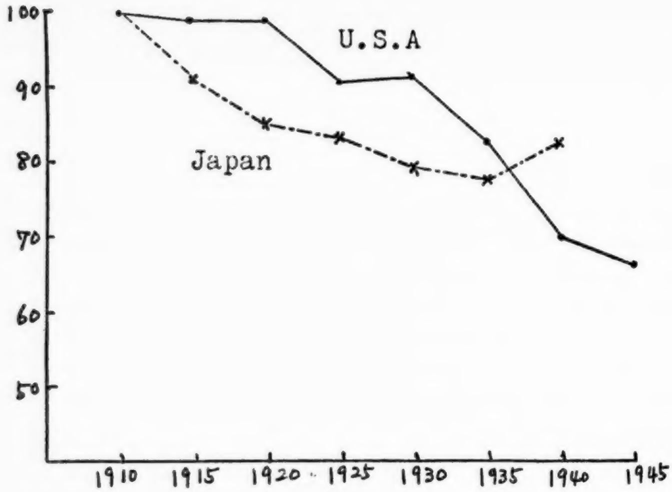

CHART 4. TRENDS OF UNIT COST IN AGRICULTURE (INTERNATIONAL COMPARISON) (1908-1912 = 100).

heating and power procurements, chemicals, money rate, and various imposts out of the items enumerated in the above-mentioned expenditures. The expenses for fodder, nursery etc. are excluded, since the latter are procured within the agriculture enterprise itself.

The labor expenses have been calculated from the farm wages per day multiplied by the total number of days in which the working members of families were engaged in farming.

The cultivated area is based on the corresponding figures appearing in the "Agricultural Abstract" for the years after 1905. For the years 1881-1907, the figures of the privately owned taxable land, including both paddy and non-paddy fields, taken from the "Imperial Statistical Year Book," have been inflated by multiplying by 104.3, which constitutes the gap between the five-year average for 1903-07, taken from the "Imperial Statistical Year Book," and the three-year average for 1905-07, taken from the above-mentioned "Agricultural Abstract."

The estimated population gainfully occupied in agriculture has been derived from the census figures. The figures were obtained from *Nihon no Keizai to Nōgyō. op. cit.*

The total capacity of energy, shown in horsepower equivalent, includes both cattle and horses used for cultivation, and after 1920 it also includes motors, oil engines, gas engines, and steam engines in their capacity expressed in horse-power, and all figures are derived from the "Agricultural Abstract." In converting the number of cattle and horses into horse-power, the following method of estimation was used: a normal horse = 0.6 HP, a cross-bred horse = 0.8 HP, and cattle per head = 0.5 HP. From 1878 to

1920 the only energy utilized in agriculture was that of horses and cattle. In order to obtain the number of horses and cattle used in cultivation (which is unknown for the years prior to 1920), an estimate was made, based on the assumption that the ratio between the total number of horses and cattle appearing in the "Agricultural Statistics" and the number of those used in cultivation only, as appearing in the "Agricultural Abstract" for 1920, was true for the years prior to 1920 as well.

Fertilizer consumption has been obtained through deflating the value of consumption by the fertilizer price index. The former is based on the "Fertilizer Abstract" for the years after 1912 and on the "Survey of Principal Purchased Fertilizers" (1926), compiled by the Agricultural Affairs Bureau, Ministry of Agriculture and Commerce, for the years 1903 to 1911; and the latter is based on the consolidated price index of fertilizers. (See *Nohon no Keizat to Nōgyō*, p. 398.) For the years 1878 to 1899, nitrogenous fertilizer such as fish manure on bean-cake, has been calculated in terms of its equivalent in ammonium sulphate.

The production index is based on the consolidated index including both agricultural and live-stock products (1921-25 = 100), compiled by Nagoya Commercial College.

A CASE STUDY IN CURRICULUM DEVELOPMENT*

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*University of Illinois***

The Problem in Curriculum Planning

CURRICULUM development is a matter of continual concern at all levels of formal education, whether the process be one of revision or of initiation of a new program. "We continue to experiment with general education at every level for the future manual worker, the future salesman or executive, and the most highly specialized university graduate."[1] Land-grant colleges and universities, along with other institutions of higher learning, share this concern.[2]

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* Constructive suggestions were offered by Irving Dubov during the development of this paper.

** The author was on the staff of the University of Tennessee at the time of the study here reported.

[1] Conant, James B., *Education and Liberty; the Role of the Schools in a Modern Society*, Cambridge: Harvard Univ. Press, 1953, p. 58.

[2] Presidential address of C. C. French, also president of Washington State University, *Proceedings of the American Association of Land-Grant Colleges and State Universities*, 1959, p. 23. This concern for curriculum adequacy in agricultural study is not limited to National boundaries, according to D. G. Dalrymple's "Higher Education and Soviet Agriculture," *J. Farm Econ.*, Feb. 1960, pp. 160ff.

Schools of agriculture in these land-grant institutions face special problems in curriculum revision and development arising from the changing orientation of instruction. While the original emphasis was primarily on the limited objective of taking "scientific agriculture" to the farm, today 85 per cent of the 15,000 new professional agricultural workers needed each year must be trained for careers *off the farm.*[3] One of the important steps taken to effect this adaptation of agricultural curricula to such changing needs has been the development and revision of the Agricultural Business programs in land-grant colleges of agriculture.[4] The recent revision of the Agricultural Business curriculum at the University of Tennessee is the case in point.[5]

Revisions in curricula are frequently precipitated by economic, technological, or social changes in the environment. Where once the environment into which the student product of most agricultural curricula moved was farm oriented, now it has become urban oriented; where once the environment was dominated by manual skills, now it has become dominated by managerial abilities; where once it was characterized by the independent worker, now it has become characterized by the interdependence of the farmer and the rest of society.

Curriculum development involves two crucial questions: What are the competencies to be achieved? What courses will contribute to those competencies? Though the consideration of these questions may be sequential by necessity, the final decision on either comes as a part of an integrated judgment on both.[6]

Quest for Curriculum Suggestions

Once the need to consider revising a curriculum has been established, those responsible must decide on a *modus operandi.* In this case sug-

[3] *Careers Ahead,* Association of Land-Grant Colleges and Universities, 1955, pp. 2-3.

[4] Agricultural Business as a conceptual category perhaps received its greatest impetus via the studies in Agribusiness dramatized particularly by J. H. Davis; for example, Davis and Goldberg, R. A., *A Concept in Agribusiness,* Boston: Harvard Grad. School of Bus. Admin., 1957, 136 pp. Six of the eleven Southern land-grant institutions have initiated a major in Agricultural Business in the past five years. Lanham, B. T., Jr., "Changing Agricultural Curricula in Agricultural Economics and Rural Sociology to Meet Current and Future Needs," *Proceedings, Agricultural Economics and Rural Sociology Section, Association of Southern Agricultural Workers,* 1960.

[5] There had been a 4-year curriculum in Agricultural Business at the University of Tennessee since 1928 but its structure prior to revision was similar to that usually found for a straight Agricultural Economics or Farm Management major. The following members of the Department of Agricultural Economics and Rural Sociology served on the committee, with the author as chairman, to produce the curriculum which is the subject of this paper: Irving Dubov, M. L. Downen, C. E. Fuller, W. P. Ranney, T. J. Whatley.

[6] The logical shortcoming of separating ends and means or goals and programs in any functional analysis is well developed elsewhere. Dewey, John, *Theory of Valuation,* Chicago: Univ. of Chicago Press, 1939.

gestions were gleaned from a variety of sources over a period of several months. A basic reservoir of ideas for curriculum development is found in the research studies of psychology, philosophy, and educational theory. Fortunately for this staff, a concerted effort had been underway for several years to improve the total program of instruction in the College of Agriculture by means of a staff seminar.[7] Effort given in this seminar to provoke both thought and reading on such subjects as the philosophy of education, teaching methods, curriculum, and motivation proved fruitful of ideas for the revision of the Agricultural Business curriculum, particularly with reference to the student competencies to be developed. The unique and varied background of knowledge of the curriculum planners, including specialization in philosophy, education, and humanities, also offered a rich resource.

Another source of ideas for the committee was the experience of other universities in regard both to research directed at curriculum problems and to actual curriculum structure. Certainly the most comprehensive, relevant study was the California investigation into the employer needs for workers in agricultural business industries.[8] From this study, insights were obtained concerning levels of education desirable for agricultural workers, importance of farm experience, programs of instruction most valued, courses to be emphasized and place of on-job training as a part of the

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[7] Due to the efforts of several of the Deans of Instruction in the Southern states, including Dean N. D. Peacock of Tennessee, an annual summer workshop for selected staff members from the various land-grant colleges has been held, beginning in 1955, focusing on such themes as: Teaching Philosophy and Methods, Principles of Learning, Motivation and Counseling, and Communications in Classroom and Laboratory. (From 1958 to present, the workshop has been supported by grants from the Danforth Foundation, Sears-Roebuck Foundation, and Farm Foundation.)

Since 1957, a program of instruction improvement involving workshops, study groups, and discussions has been in operation throughout the academic year for the entire staff of the College of Agriculture, University of Tennessee.

[8] This study involved information obtained from 327 businesses in 14 towns and cities. An immediate consequence was the initiation of experimental Agribusiness curricula in four junior colleges in California. *Report of a Study, Traning Required by Workers in Agricultural Business and Industry,* Calif. State Dept. of Educ., 1957; A Progress Report, *Pilot Studies to Develop Junior College Curricula in Agri-Business,* Calif. State Dept. of Educ., 1957; *A Summary Report of an Agri-Business Study, the Agricultural Pilot Studies, and the Agri-Business Community Studies,* Calif. State Dept. of Education, 1958.

See also their *Report of a Study, Training Requirements of Workers in the Production and Distribution of Nursery Plants,* Calif. State Dept. of Educ., 1959.

Other references include: (1) "Curriculum in Food Distribution," mimeo. report of Natl. Assoc. of Food Chains, Nov. 1958; (2) Talk by T. T. Oyler, Vice-President of Kroger Co. concerning his company's interest in Agriculture and Home Economics graduates, Nov. 12, 1958; (3) Geyer, Dick, "Are Agricultural Colleges Keeping Pace?" in *Agricultural Leader's Digest,* Jan. 1959, p. 12; (4) Wendler, Henry G., "Agribusiness Grads are Needed in Food Technology," *County Agent and Vo-Ag Teacher,* Dec. 1959, pp. 24 ff.; (5) "Opportunities for College Graduates in the Feed Industry," Amer. Feed Mfrs. Assoc., Aug. 1950.

curriculum. One of the most specific findings was the emphasis given by the employers to "general education," business education, and speech.

The experiences of other institutions with agricultural business curricula were obtained by the committee from ten land-grant colleges. These were selected to represent different regions and different sizes of colleges, and included some institutions that had recently revised their curricula.[9] The composition of each of these curricula as to courses and units of credit was studied and compared to the existing program at Tennessee. Not only did this comparison furnish valuable suggestive information to the committee but it also served as a useful vehicle of enlightenment to the College staff and administration.

Alumni were also a source of ideas on curriculum matters and, finally, students presently majoring in Agricultural Business and Agricultural Economics and the entire departmental staff (extension, research and teaching) were solicited for ideas concerning the curriculum. Probably the strongest expression made by the students was a plea for work more advanced than is presently found in the beginning courses of the various agricultural departments.

None of the above sources of ideas appropriated by the committee could supply *the answer on curriculum matters.* However, the final decision was surely improved by giving consideration to the research results, experiences, and beliefs of such interested parties as professional colleagues, prospective employers, alumni, and students currently enrolled in existing programs. The background had been set for answering the first question: What are the competencies to be achieved?

Identifying Areas of Competence—Configuration of a Student Product

Curriculum development is more than gathering together a bundle of courses; it is a process designed to produce a particular product—a graduate with a desired level of achievement.[10] However, the general objective of a "well-educated graduate" gives little insight for specific planning. Neither is it fruitful to examine laboriously every single course presently offered or that could be offered by an institution, with a view toward

[9] Curricula studied included those offered by South Dakota State College, Louisiana State University, North Carolina State College, Auburn University, University of Florida, Purdue University, Pennsylvania State University, Texas A & M College, Iowa State University, and Michigan State University.

[10] It should be noted that the term curriculum takes on various meanings in written and spoken expressions. They are briefly: (1) the total set of experiences planned in an educational effort for student development; (2) a general pattern of required and elective course credit available for students in a field of study; and (3) a specific course of study for a particular student. In this paper, curriculum refers to the second meaning, somewhat arbitrarily, because of customary use in many agricultural colleges. The author believes firmly that regardless of the quality of curriculum planning accomplished, as outlined herein, those phases of education implied in the other two meanings are of utmost importance.

using it in a particular curriculum. Some functional objectives for the curriculum are needed. The problem can perhaps be best approached by moving step by step from a very generalized notion of a "well-educated student" to more specific characteristics of the student product. Such characteristics can then serve as ends-in-view for further revision and as guides for appraising specific course content in the curriculum. One prominent group of workers in the curriculum development field characterized the process as being composed of four parts which include determination of educational direction, choosing means to plan the instructional program, selecting the particular curriculum organization, and evaluation.[11]

In the case of curriculum revision under study, the faculty committee did select as tentative guides such a hierarchy of competencies for the Agricultural Business graduate.[12] The most generalized competency desired of the "well-educated student" was the ability to recognize, formulate, and "satisfactorily" resolve all problems with which he would be confronted as an individual, a member of society, and a professional worker; thus, a problem-solving capacity should be the major rather than a minor objective in building the revised curriculum. "Men and women studying, thinking, and writing in libraries, research institutes, museums, and universities, as well as the lone scholar, writer, and artist—all have one attribute in common: *They are all engaged in a creative activity whose product each one hopes will have significance for a long period of time.*"[13]

Identification of competencies within this problem-solving context was then approached on two fronts in the following order: (1) those abilities all college graduates should have and (2) those additional abilities needed by the agricultural business graduate. The following outline sketches the competencies found, from the varied avenues of search cited previously, vital to the capacity of every college graduate to meet individual, social, and professional problems.

A. Areas of knowledge with which the student should be generally acquainted and about which he should understand available sources of knowledge
   1. Understanding the social environment
      a. How it developed
         (1) World

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[11] Smith, B. O., Stanley, W. O., and Shores, J. H., *Fundamentals of Curriculum Development*, Yonkers-on-Hudson, New York: World Book Co., 1957, p. vii.

[12] An attempt to conceptualize the characteristics of the student product is at best a groping, tentative, and somewhat arbitrary process; yet, in proper use it can provide direction for curriculum planning. Some diverse and interesting sets of objectives (e.g., objectives of self-realization, human relationship, economic efficiency, and civic responsibility) are considered in McNerney, C. T., *The Curriculum*, New York: McGraw-Hill Book Co., 1953, pp. 3 ff.

[13] Conant, J. B., *The Citadel of Learning*, New Haven: Yale Univ. Press, 1956, p. 6.

(2) National and local

b. How it functions

(1) Human interrelations

(2) Governmental organization

(3) Idea development

(4) Production and consumption activities

2. Understanding the physical and biological environment

a. Life processes, plants and animals

b. Chemical relationships in our environment

c. Physical forms and forces

B. Abilities to be developed relevant to the communication of knowledge

1. Communication by writing

2. Communication by speaking

3. Receiving communication by reading, listening, and observing

C. Proficiencies for analytical thought and effort

1. Logical conceptualization

2. Elements of scientific research methodology

3. Tools of empirical measurement and analysis

D. Propensity for continued learning

In addition to these competencies, which the committee agreed were desirable for all college graduates, other more specific and highly developed competencies were judged vital for the Agricultural Business student. This student is preparing for professional work in the business community, either public or private, where agricultural products, supplies, or services are a prime object.[14] Economic and social organizations are the prominent vehicles. Thus, different from many specialists who must learn to work expertly with plants, animals, or physical forces, the Agricultural Business graduate should be equipped to work expertly with people in their wealth-getting and wealth-using activities. Such work entails unusual facility in communication, problem formulation, management, institutional process, and personnel relations. The following outline sketches briefly these more specialized competencies. It is recognized that preparation for a particular Agricultural Business career, such as an agricultural representative in a commercial bank or a buyer with a packing plant, would be further pursued by judicious use of elective credits.

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[14] Previous systematic examinations relevant to some of the specific problems of the Agricultural Business curriculum include: Booth, E. J. R., "Some Fundamental Problems Concerning Undergraduate Curriculum in Agricultural Economics," *J. Farm Econ.*, Dec. 1958, pp. 1866-70; Brinegar, G. K., "Teaching Economics in Colleges and Universities," *J. Farm Econ.*, Nov. 1956, pp. 991-7; Kohls, R. L., "Goals of Undergraduate Instruction in Agricultural Economics," *J. Farm Econ.*, Dec. 1959, pp. 1406-15. Also see Nicholls, W. H., "Higher Education and Agricultural Economics: A Critical Appraisal," *J. Farm Econ.*, Dec. 1960, pp. 969-90.

Specialized knowledge with which the student should become familiar, or more familiar than other college graduates, includes:

A. Economic and social organizations and sources of knowledge about them
   1. Individual human behavior
   2. Group interaction in community, industrry, and government
   3. Advanced economic analysis
   4. Monetary and fiscal processes
   5. Public and private firm and organizational management
   6. Legal aspects of business and government
   7. Economic and political systems
   8. Firms and organizations peculiar to agriculture
   9. Development of agriculture, and public policies relating to it
B. The processes of dissemination of information
   1. Technical composition
   2. Mass media of communication
   3. Business reports
   4. Interpretation of technical information for the general public
C. Conceptual and quantitative research methods
   1. Research organization in specific problem areas
   2. Specialized types of data analyses
D. Key processes in particular segments of the agricultural industry relevant to the career

These two groups of competencies were tentative and instrumental as they guided the search for the courses and subject-matter content of the curriculum. Thus, guides were available for answering the second question: What courses will contribute to the desired competencies?

Structuring the Agricultural Business Curriculum

A. Particular problems in course selection

Five problems encountered in selecting specific courses deserve particular note: (1) use of integrated courses, (2) extent of introduction to each basic field, (3) amount and composition of technical agriculture requirement, (4) on-job (co-op) management experience, and (5) role of electives.

Wherever integrated basic courses were available combining subject matter contributing to the desired competencies, they were selected to provide breadth and continuity in understanding.

There was the question of the comparative advantages of taking the full introductory sequence (2-3 courses) in a few basic fields to provide depth as against selecting a course or two in all the fields to provide some acquaintance with more subject matter. The committee tended to the latter choice, as it was recognized that most of the farm youth have

very limited knowledge concerning the scope and diversity of various disciplines of research.

To recognize that an Agricultural Business curriculum is a combination of business and agriculture tells little about how much of either.[15] In deciding the amount of technical agriculture, the committee concluded that since most students would have some background experiences in agriculture, the courses chosen should build upon that experience and shore up deficiencies. Therefore, all students did not need to study in every agricultural field. As a result the curriculum calls for 18 quarter hours of agricultural subjects (in addition to basic agricultural economics) some of which must be in each of the three following areas: plant science, animal science, and engineering.[16]

Another problem receiving attention was the advisability of on-job (co-op) training in some agricultural business.[17] It is anticipated that such would be a worthy addition to the curriculum at a future date and is already provided for through college-wide co-op course credit.

Finally, the committee considered the question of electives in the program. The consensus was that a substantial block of total required credits should be left for the student to develop his own program by selecting subject matter not provided for or by selecting advanced courses in specialized areas.

B. Make-up of the agricultural business curriculum

With the problem of curriculum development formulated, ideas solicited from various sources, desired competencies identified, and alternative subject matter courses examined, a final curriculum was designed (see Table 1).

Upon completion of the revised curriculum, the departmental com-

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[15] Consideration of curriculum problems for certain agricultural careers appears in: Heady, Earl O., "Adaptation of Extension Education and Auxiliary Aids to the Basic Problem of Agriculture," *J. Farm Econ.*, Feb. 1957, pp. 112 ff; Parsons, K. H., "U.S. Training for Foreign Students in Agricultural Economics," *J. Farm Econ.*, May 1957, pp. 235-49; Love, Harold C., "Educational Requirements for Extension Workers with Suggestions on In-Service Training," *J. Farm Econ.*, May 1958, pp. 361 ff.

[16] This plan was developed as a result of the pioneering efforts of the Colleges of Agriculture at both Michigan State University and North Carolina State College. At the latter, curricula were established in agricultural science, agricultural business, and agricultural technology, while at Michigan, new integrated courses in plant science, animal science, genetics, agricultural engineering, and agricultural economics were developed for lower division offerings. For some elaboration on one of these plans, see James, H. B., "The Philosophy of Undergraduate Instruction," *J. Farm Econ.*, Dec. 1959, pp. 1398-1405.

[17] Perhaps the best example of such a program is in operation at Iowa State University, where a junior or senior major spends a quarter, for which he receives credit, on-job with an agricultural business under joint supervision of the employer and a staff member. Staff personnel involved in this program were personally contacted by the committee in seeking information.

TABLE 1. COMPOSITION OF FOUR-YEAR AGRICULTURAL BUSINESS CURRICULUM DEVELOPED AT UNIVERSITY OF TENNESSEE, 1959

Subject-matter areas specifically included	Quarter-hour credits
I Social Sciences (economics, history, political science, psychology, sociology)	39
II Biological Sciences (botany, zoology, agricultural plant science, agricultural animal science)[a]	27
III Physical Sciences (chemistry, geology, physics, agricultural engineering)	24
IV Communications (English, journalism, speech, business report writing)	21
V Analytical Thought and Measurement (mathematics, philosophy, statistics)	18
VI Business (accounting, business law, finance, marketing)	18
VII Agricultural Economics and Rural Sociology	30
VIII Military Science and Physical Education	8
IX Electives	27
Total	212

[a] Agricultural animal science requirement (6 hours credit) includes credit in any one or combination of animal husbandry, dairying, and poultry. Agricultural plant science requirement (6 hours credit) includes credit in any one or combination of the fields of forestry, horticulture, and agronomy.

mittee carefully prepared statements for the various curriculum committees and staff, setting forth the genesis of the program, pertinent data relevant to the previous unrevised curriculum and to those of other schools, and an explanation as to the place of each course and allocation of credit in the proposal. Somewhat surprisingly, the revised curriculum was approved *in toto* with solid support both from the agricultural and nonagricultural staffs. The revision has been in effect too short a time for a meaningful appraisal of its merits in practice.

A NOTE ON THE APPLICATION OF LINEAR PROGRAMMING BY AGRICULTURAL ECONOMICS DEPARTMENTS OF LAND GRANT COLLEGES

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LINEAR programming has for a long time been, and to some extent still is, a technique which has been viewed by many with considerable suspicion and extensive doubts about its usefulness and "length of

* The authors gratefully acknowledge suggestions and support obtained from

life." But a recent survey[1] has shown that linear programming has seemingly found a permanent place among the prominent methods used in solving research, management and extension problems in agricultural economics. In 1960, almost all agricultural economics departments at land grant colleges employed linear programming as a technique in some of their research projects. The majority of departments also made efforts to teach the technique to their students, either in especially designed courses or in courses the prime objective of which was other than teaching linear programming. About 30 per cent of the departments used, or planned to use, linear programming in extension (Table 1).

Comments by those who use linear programming do not give the impression that linear programming is used for its own sake. Rather, the problems generally appear to be conceived and defined before the use of linear programming is decided upon. Also, limitations of the linear programming approach are recognized. This survey suggests that those who employ the linear programming technique recognize basically two types of limitations. One is the lack of availability of sufficiently detailed and suitable input-output data, and the second is the difficulty of constructing a linear programming model which realistically represents relevant relationships and alternatives.[2]

Interestingly enough, the lack of availability of suitable data was most strongly, as a matter of fact almost exclusively, felt to be a serious limitation to the general applicability of linear programming by those departments who had most recently undertaken research with linear programming as a research tool. And, in turn, these departments tended to consider the highlighting of the deficiency in technical data a contribution by linear programming.

Those departments (or more specifically individuals), usually at larger universities, who have worked with linear programming for a number of years, have presumably made up the deficiency in technical data. This may have been accomplished through a more skillful and effective use of what data are available, by stimulating colleagues in other fields to supply the needed data, or by procuring the data themselves. At any rate, they are now concerned with the second limitation mentioned above, namely that of constructing programming models which realistically represent relevant relationships and alternatives.

Professor Richard A. King, North Carolina State College, during the planning stage of this survey, as well as the cooperation received from the staffs of the land grant colleges.

[1] In May, 1960, questionnaires were sent to all agricultural economics departments at land grant colleges. Forty-seven completed questionnaires were returned.

[2] Available computer facilities or computing costs were not considered a serious limitation.

TABLE 1. APPLICATION OF LINEAR PROGRAMMING IN AGRICULTURAL ECONOMICS DEPARTMENTS OF 47 LAND GRANT COLLEGES, 1960

How linear programming is utilized	Number of Departments
Used in research	41
Used in extension	14[a]
Planned to be used in extension	7
Taught—	
(a) in a course specifically designed for it	12
(b) as part of a course the prime objective of which is other than teaching linear programming	31

[a] This figure likely understates the usefulness of linear programming to extension work, since the results and insights about existing relationships as portrayed by the linear programming model undoubtedly are utilized in extension work, although the technique as such is neither studied nor applied explicitly to a particular extension problem.

Attempts to adapt and expand models to approach real world conditions more closely are being made, but these attempts are relatively few and good results are even scarcer (Table 2). This should not be surprising, since these models tend to become large rapidly, the mathematics becomes involved, and although answers can be obtained, the reasons for a particular answer are difficult to explain. The latter difficulty represents a considerable loss of information relative to the standard linear programming model, where the relationships which brought about a particular solution could easily be followed and the information thus gained was frequently of more value than the solution itself.

In connection with model adaptation to real world conditions, it is interesting to note that the application of linear programming has primarily occurred in the field of farm management (Table 3), i.e. in a field where it would seem more difficult to adapt models than in much of agricultural marketing as generally defined. This may be because marketing firms tend to do their own programming and/or because the pioneer applications of linear programming in agricultural economics were made by individuals

TABLE 2. MODIFICATIONS OF THE STANDARD MODEL WHICH ARE EMPLOYED IN AGRICULTURAL ECONOMICS DEPARTMENTS OF 47 LAND GRANT COLLEGES, 1960

Type of model	Number of departments employing the model
Transportation	17
Variable price programming	10
Dynamic programming	9
Variable resource programming	6
General equilibrium model	3
Other[a]	5

[a] Reactive programming, integer programming, non-linear programming, convex programming, stochastic programming.

TABLE 3. SUBJECT MATTER AREAS OF APPLICATION OF LINEAR PROGRAMMING IN AGRICULTURAL ECONOMICS DEPARTMENTS OF 47 LAND GRANT COLLEGES, 1960

Subject matter area	Number of departments
Farm management	40
Agricultural Marketing	24
Agricultural production economics	6
Agricultural policy	4
Consumer economics	2
Other[a]	8

[a] Aggregate supply studies, agricultural business management, interregional competition, area adjustment, coal mining.

whose primary interest was in farm management and agricultural production economics.

While 41 departments replied they used linear programming in research work in 1960, as many as 43 indicated that they taught the technique of linear programming to their students (Table 4). This is undoubtedly one of the reasons why much of the research where linear programming is employed is now carried out by M.S. candidates, while this was formerly (before about 1958) almost exclusively the domain of Ph.D. candidates or accomplished researchers.[3]

TABLE 4. YEARS OF INCORPORATION OF THE LINEAR PROGRAMMING TECHNIQUES INTO VARIOUS PROGRAMS OF AGRICULTURAL ECONOMICS DEPARTMENTS OF 47 LAND GRANT COLLEGES

Year	Number of departments which in a specified year began to:			
	Teach linear programming—		Use linear programming in research	Use linear programming in extension
	in a specially designed course	as part of another course		
1950	—	—	1	—
1951	—	—	—	—
1952	—	1	2	—
1953	—	1	3	—
1954	2	2	7	1
1955	1	4	3	2
1956	2	5	6	2
1957	4	4	4	1
1958	3	1	6	2
1959	—	4	7	4
1960	—	5	2	2
No date stated	—	4	—	—
Total	12	31	41	14

[3] See Erwin M. Reisch and Ludwig M. Eisgruber, *Bibliography of Linear Programming and its Application to Agricultural Economics Problems* (September, 1960), Mimeo., Dept. of Agr. Econ., Purdue Univ., 1960.

The fact that the generally used standard model has been tested to the extent that it can be applied to many problems in an almost routine-like fashion must not lead to the conclusion that the linear programming technique has now been mastered. This survey indicates that most researchers believe that the standard model should be altered in order to be usable for a variety of problems. But the researchers are at the same time concerned about the rapid increase in complexity of the model thus modified. This concern suggests that the tabulations presented in this note tend to present an overly optimistic picture of the state of knowledge about mathematical programming. While the technique of linear or mathematical programming is rather widely used and extensively taught, the potential of the technique in agricultural economics research and application is far from being fully explored. Chances are that much of the work with linear programming presents not much more than a good beginning.

BUDGETING AND LINEAR PROGRAMMING CAN GIVE IDENTICAL SOLUTIONS

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A PREVALENT notion is that linear programming gives better answers than budgeting.[1] An example of such notion is implied in a question asked by Fox: "Is the net profit obtainable via the linear programming solution one percent, five percent or ten percent higher than that arrived at through the budgeting approach?"[2] It is frequently pointed out in the literature that the two techniques are parallel in many respects except that linear programming always gives the unique optimum solution whereas budgeting gives solutions on a "trial and error" basis. While the distinction is a valid one it may be misleading in the sense that it casts doubts about the comparability of the techniques. It suggests that only by chance will the two techniques produce identical solutions to a problem.

My purpose is to demonstrate that budgeting and linear programming can produce the same solution. To accomplish this purpose both techniques will be applied to a typical profit maximization problem. It will be

* Appreciation is extended to S. K. Seaver and T. C. Morrison of the University of Connecticut who reviewed the paper and offered valuable suggestions.

[1] There may also be a notion held by some persons that budgeting gives better answers than linear programming in the sense that it can readily deal with economies of size relationships. Both notions are subject to question in this note.

[2] Fox, Karl A., "The Current State of Agricultural Economics: Methods and Potentials in Agricultural Economics Research," *J. Farm Econ.*, 41:914, Dec. 1959.

assumed that the reader has a working knowledge of the fundamentals and mechanics of both techniques. Nevertheless the presentation of some elementary computations will be necessary in order to trace the data through the steps and to reveal that the data are the same for each technique. A strengthening of the link between the two techniques will encourage greater use of both for solving actual on-the-farm problems.

The Problem Chosen for the Demonstration

Suppose a farmer installed a loose housing and milking parlor dairy system a year ago and has been milking 100 cows. After a year's operation it has become evident that hired labor and milking facilities are not being used to capacity. One of the limitations to a further increase in the herd size is the forage supply which is produced on the farm. The farmer has three possible alternatives under consideration. One, he could buy additional forage (hereafter referred to as Alternative A). Two, he could transfer forage from young stock to milking cows and buy replacement cows instead of raising them (Alternative B). Three, he could have some combination of the first two (Alternative C).

Obtaining the Solution Using Budgeting

Since this problem is concerned with the changes to an existing farm business, only the items affected by the changes are computed. I prefer to use this approach because it simplifies the presentation and is consistent with marginality concepts. However, it is not necessary to use the "changes in costs and returns" approach to obtain identical solutions. The "total costs and returns" approach also produces identical solutions.

As a means of identifying certain computations I have divided the budgeting into two steps. Step I is a determination of the possible extent of the adjustment under consideration. Step II involves the computation of the changes in costs and returns based upon the extent of adjustment determined in Step I.

There are two ways to do Step I. One is to arbitrarily pick some reasonable number of cows to be added, say 20 cows, and proceed on that basis. This is the "trial and error" approach and it may give the same solution as linear programming, but it would only happen by chance. The other method is to systematically fit the adjustment to the available resources. In general practice, the "resource balancing" part of budgeting usually consists of a set of tables showing a balance between the quantity of available resources and the input requirements. It is this latter method that is most useful for obtaining the same solution as linear programming.

An application of the "resource balancing" method to the problem at

hand results in an answer of 40 cows for Step I.[3] Computations for this are shown in Table 1 in a somewhat condensed form. All three alternatives are included in the table, but the extent of adjustment shown in the fourth column applies only to Alternative C (a combination of "buy additional forage" and "buy replacement cows"). For Alternative C the resources of the first column plus the resources released from young stock production in the second column are available. The most restrictive resource for Alternative C is winter labor, which restricts herd expansion to 40 additional cows (800 hrs. ÷ 20 hrs. per cow = 40). Forage is not restrictive for Alternative C because any amount can be purchased. If Alternative A

TABLE 1. COMPUTATIONS TO DETERMINE THE EXTENT OF ADJUSTMENT

	(1) Resources Available for the Change		(2) Resources Previously Used for Young Stock		(3) Resources Required per Additional Unit (Cow+Repl.)		(4) Extent of Adjustment (Additional Cows+Repl.)
Capital	$5,000	+	$7,500	÷	300	=	41.7
Labor (winter)	300 hrs.	+	500 hrs.	÷	20	=	40
Labor (summer)	200 hrs.	+	350 hrs.	÷	10	=	55
Forage	quantity purchased	+	100 tons	÷	5	=	20+

(buy additional forage) is considered alone, then only the resources of the first column are available. Again winter labor is the most restrictive resource and it limits herd expansion to 15 additional cows (300 hrs. ÷ 20 hrs. per cow = 15). Forage cannot be restrictive, by definition of Alternative A. Finally, if Alternative B is considered alone, then the resources of columns one and two are available except that the available forage is only the 100 tons released from young stock production. In the case of Alternative B, forage is the most restrictive resource and it limits herd expansion to 20 additional cows (100 tons ÷ 5 tons per cow = 20). Of the three alternatives, Alternative C permits the highest level of adjustment—40 cows; therefore it is the one chosen to be budgeted.

Step II of the budgeting is to determine the costs, returns and effect upon net income of adding 40 cows, purchasing 100 tons of hay, and substituting 25 purchased replacement cows for 50 head of young stock (Table 2).[4] It should be observed that the costs and returns are calculated

[3] Here and in the subsequent discussion the name of the unit is shortened from "cows plus replacement" to just "cows" although the calculations do include the replacement.

[4] An adjustment of this type and magnitude will ordinarily require a transition period between entirely raising young stock and entirely purchasing replacements. The budget presents an estimate of the change in annual net income *after the adjustment has been completed.* It does not deal with the transition period as such.

TABLE 2. A BUDGET OF BUYING REPLACEMENTS INSTEAD OF RAISING THEM, BUYING ADDITIONAL HAY AND EXPANDING THE HERD BY 40 COWS

Changes in Returns:		
Added Returns:		
Milk, cull cows, calves, 40×$540[a]	$21,600	
Calves (normally kept for y.s.) 25×$15	375	
	$21,975	
Reduced Returns	0	
Subtotal A		$21,975
Changes in Costs:		
Added Costs:		
Grain, etc., for added cows plus repl., 40×$230[b]	$ 9,200	
Purchased hay, 100 tons×$40	4,000	
Purchased replacements (to substitute for raised), 25×$300	7,500	
	$20,700	
Reduced Costs:		
Grain, etc., for raised y.s., 50×$74	3,700	
Subtotal B		$17,000
Estimated Change in Annual Net Income		+$ 4,975

[a] The annual returns per cow are $500 for 10,000 lbs. milk, $25 for .25 cull cow and $15 for one calf. The total number of additional cull cows sold is 10.

[b] The annual costs per cow are $120 for grain, $13 for breeding and vet., $10 for bedding, $12 for DHIA, and $75 for a replacement. For sake of simplicity, no allowance has been made for interest and insurance.

as "whole change" totals. In linear programming the costs and returns are computed on a "per process unit" basis. This difference will be given further attention in the discussion of the linear programming solution.

As shown in Table 2 the budget solution is a $4,975 increase in net income associated with Alternative C. Is it a maximum profit solution? The customary interpretation of a positive budget solution is that it is in the direction of maximum profits. It will be shown in the following section that the +$4,975 solution agrees with the linear programming maximum profit solution.

Obtaining the Solution Using Linear Programming

For comparison purposes it is useful to think of the linear programming procedure as comprising three steps.[5] They are somewhat in reverse order of those for budgeting. Step I of linear programming is to compute the costs and returns whereas this computation was the last step of budgeting. The second step of linear programming is to list the restrictive resources

[5] Computational detail is necessarily omitted since it is adequately covered in the literature. For example see: Heady, E. O., and Candler, W., *Linear Programming Methods,* Iowa State College Press, Ames, Iowa, 1958; McAlexander, R. H., and Hutton, R. F., *Linear Programming Techniques Applied to Agricultural Problems,* Pa. Agr. Expt., Sta., A.E. & R.S. No. 18, May 1959.

TABLE 3. PROCESS BUDGETS OF THE ALTERNATIVES UNDER CONSIDERATION FOR THE DAIRY FARM

	Milking and Feeding (Per Cow Plus Replacement)	Purchase Hay (Per Ton)	Substitute Purchased for Raised Replacements (Per Head of Young Stock)
Process Index	P_1	P_2	P_3
Changes in Returns:			
Added	$540	0	$15×.5=$7.50
Reduced	0	0	0
Subtotal A	$540	0	$7,50
Changes in Costs:			
Added	$230	$40	$300×.5=$150.00
Reduced	0	0	74.00
Subtotal B	$230	$40	$ 76.60
Net Change in Revenue (A−B)	$310	−$40	−$ 68.50

and the input requirements (coefficients). It corresponds somewhat to Step I of budgeting. The third step, a simultaneous mathematical manipulation of Steps I and II, does not have a similar counterpart in budgeting.

Step I of the demonstration problem is set up with three process budgets (Table 3). One process budget is for the addition of cow units and the other two are for Alternatives A and B. It should be observed that the costs and returns are on a "per process unit" basis. By referring back to Table 2, the reader can observe that these unit data were used in the budget to obtain the "whole change" in costs and returns.

Completion of the second step for the demonstration problem results in a listing of data as shown in Table 4. Two items in Table 4 may need explanation. One is that the negative coefficients denote the quantity of a resource that a process will supply rather than use. Another is that 50 head

TABLE 4. RESOURCE RESTRICTIONS AND RESOURCE REQUIREMENTS (COEFFICIENTS) PER UNIT OF PROCESS OF THE ALTERNATIVES UNDER CONSIDERATION FOR THE DAIRY FARM

	Resource Restrictions	Resource Requirements		
		Milking and Feeding (Per Cow)	Purchase Hay (Per Ton)	Substitute Purchased for Raised Replacements (Per Head of Young Stock)
Process Index	P_0	P_1	P_2	P_3
Capital (dollars)	5,000	300	0	−150
Labor (winter hrs.)	300	20	0	− 10
Labor (summer hrs.)	200	10	0	− 7
Forage (tons)	0	5	−1	− 2
Young Stock (head)	50	0	0	1

TABLE 5. LINEAR PROGRAMMING SOLUTION FOR THE DAIRY FARM PROBLEM

C_j									310 Milking and Feeding	−40 Purchase Hay	−68.50 Replacements Substitution
1st iteration		C_i	P_0	P_4	P_5	P_6	P_7	P_8	P_1	P_2	P_3
0	Capital ($)	P_4	5,000	1	0	0	0	0	300	0	−150
0	Labor (w) (hrs.)	P_5	300	0	1	0	0	0	20	0	− 10
0	Labor (s) (hrs.)	P_6	200	0	0	1	0	0	10	0	− 7
0	Forages (T.)	P_7	0	0	0	0	1	0	5	−1	− 2
0	Young stock (head)	P_8	50	0	0	0	0	1	0	0	1
	Z_j		0	0	0	0	0	0	0	0	0
	Z_j-C_j		0	0	0	0	0	0	−310	40	68.50
4th iteration (solution)											
0	Capital ($)	P_4	500	1	−15.00	0	0	0.00	0	0	0
−40	Hay purchase (T.)	P_2	100	0	.25	0	−1	.50	0	1	0
0	Labor (s) (hrs.)	P_6	150	0	− .50	1	0	2.00	0	0	0
310	M. & F. (cows)	P_1	40	0	.05	0	0	.50	1	0	0
−68.50	Repl. Sub. (y.s.)	P_3	50	0	0.00	0	0	1.00	0	0	1
	Z_j		4,975	0	5.50	0	40	66.50	310	−40	−68.50
	Z_j-C_j		4,975	0	5.50	0	40	66.50	0	0	0

of young stock are listed as a restrictive resource in the sense that no more than this can be substituted for by purchased replacements; there are only 50 head of young stock on the farm in the present situation.

The third step is an application of the Simplex Method (Table 5). Only the first and fourth iterations are shown, in order to conserve space. The purpose of providing these two iterations is to show where the corresponding data of the budget fits into the linear programming Simplex form. As indicated in the P_0 column of the fourth iteration, the solution is $4,975 which agrees with the solution obtained by budgeting of Alternative C. The P_0 column also indicates that the solution is Alternative C since the program consists of: (1) an addition of 40 cows, (2) the purchase of 100 tons of hay, and (3) the substitution of purchased replacements for 50 head of young stock.

Would the solutions be identical if the problem were more complex? As the number of alternatives and variables increases, the more difficult it becomes to do the "resource balancing" step of budgeting. In a test of this aspect it was possible, though, to obtain identical solutions for a problem involving nine active processes and eleven resource restrictions.[6] It may be possible to obtain identical solutions for even more complex problems, but the time-consuming computations of budgeting become prohibitive. The time-saving advantage of linear programming weighs heavily in its favor for the more complex problems, particularly when an electronic computer is available.

Would the solutions be identical if the problem involved economies of size relationships? Many farm adjustments involve indivisible inputs and

[6] Analysis for Storrs Experiment Station Research Project 247. The linear programming computations were made at the MIT Computation Center, Cambridge, Mass.

costs that lead to economies of size. This particular demonstration did not include indivisible inputs. If it had, then the difference between the "per process unit" basis of linear programming and "the whole change" basis of budgeting would have had an effect on the solutions. An example of an indivisible input is a silo. If an additional silo is needed to make a change on a farm, then the full annual costs apply whether one or forty cows are added, i.e., the silo costs are not readily divisible on a "per cow" unit basis. This poses a problem of how to allocate the silo inputs on a "per cow" basis in linear programming. On the other hand, a silo input can be handled easily in budgeting because the computations are on a "whole change" basis. Some recent modifications of linear programming have helped to overcome the difficulty of dealing with indivisible inputs.[7] By using these modifications I have obtained identical solutions to problems involving economies of size relationships.

Implications and Conclusions

The fact that budgeting and linear programming can arrive at the same solution implies two benefits. One, it provides a strong basis for coordinating the use of the two techniques. Two, it strengthens confidence in both techniques and indicates that each has a place in problem solving.

One of the opportunities to coordinate their use is to use linear programming in research for solving complex farm adjustment problems and to convert the results to the budget form in reporting the results to farmers. The latter can be readily understood and utilized by farmers. In this demonstration it was shown, by comparing steps in the procedures, that the data used in one technique can easily be converted to the other technique.

Another opportunity to coordinate their use is for on-the-farm problem solving. Budgeting is a tool that a farmer can use on a do-it-yourself basis. Most of a farmer's problem solving can be done with budgeting; however, major adjustments can become too complex to solve easily. If the services of a computational center were available to the Extension Service, then the farmer could refer a major adjustment problem to the Extension Service where linear programming could be used to solve it.[8] The results could then be converted to the budget form and reported back to the farmer. As conditions change from time to time, the farmer will need to modify the solution and could do so by budgeting. Of course, budgeting is just one of several methods that can be used to modify solutions. One method involves direct modifications to the solution iteration itself.[9] Information about the opportunity costs of unused resources is available from

[7] Giaever, Harold and Seagraves, J. S., "Linear Programming and Economies of Size," *J. Farm Econ.*, 42:103-17, Feb. 1960.

[8] This type of work is being done in some states.

[9] Puterbaugh, H. L., Kehrberg, E. W., and Dunbar, J. O., "Analyzing the Solution Tableau of a Simplex Linear Programming Problem in Farm Organization," *J. Farm Econ.*, 39:478-89, May 1957.

the solution iteration. Another method is to provide farmers with price-map boundaries.[10] Some methods of modification require continual service to farmers. An ideal feature of the coordination of linear programming and budgeting is that once the major adjustment is solved, modifications can be made by the farmer himself with the use of budgeting.

The main point, however, is that the two methods are compatible. The prevalent notion that one method gives better answers than the other suggests that one should be used in preference to the other. Quite the contrary, there is a place for both, and one's confidence in each is improved by an understanding of the other. The division of work between the two techniques rests largely on efficiency grounds. In general, budgeting is the most efficient for minor adjustment problems and linear programming is the most efficient for major adjustment problems.

[10] McPherson, W. W., and Faris, F. E., "Price Mapping of Optimum Changes in Enterprises," *J. Farm Econ.*, 40:821-34, Nov. 1958.

A NOTE ON THE SMALL WATERSHED AS A PLANNING UNIT

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THE following discussion, although prompted by the paper of Pavelis and Timmons, "Programming Small Watershed Developments,"[1] is not concerned with the application of linear programming in planning small watershed programs. Data provided by the authors in this article and elsewhere,[2] however, raise a question of the value of using the small watershed as a unit of planning or programming.

Because the watershed has been designated as a unit of planning under Public Law 566, the planning program is constrained to structural and land use changes which come within a single watershed. Since those improvements are planned first which have the highest rate of return, the ratio of net annual benefits to total annual costs declines as the total annual costs increase. In the Nepper watershed described by the authors, after initial changes have been made for which the authors indicate there may be a high rate of return, less profitable measures must be adopted, although annual net benefits are maximized at benefit-cost ratios greater than 1.

If the same method were used in evaluating an area containing more than one watershed, however, the returns from a given investment might well be greater. Let us assume, for example, that each small watershed possesses similar characteristics and problem areas. Here, it should prove

[1] *J. Farm Econ.*, 42:225-40, May 1960.

[2] Pavelis, G. A., and Timmons, J. F., "Linear programming: a new tool for watershed planning," *J. Soil and Water Conservation*, 15:5-10, 1960.

most economical to choose initially those improvements or conservation measures which provide the highest return throughout the larger area. If, instead of assuming identical watersheds, a combination is considered in which some watersheds have benefit-cost ratios for each level of investment higher than those for the Nepper, the added benefits from programs covering several watersheds would be even higher. It would appear then that where funds are limited, as long as measures providing high benefit-cost ratios can be performed elsewhere, confining the program to a single watershed will reduce the net annual benefits.

Public Law 566 provides that the drainage area for which a program may be developed must be no more than 250,000 acres or 381 square miles. Using Horton's[3] quantitative analysis of drainage basin characteristics, one finds that in Iowa a stream having a drainage area of 381 square miles will in general be of fifth or sixth order. The Nepper watershed with a drainage area of 480 acres (0.75 square miles) is about a first or second order tributary. This means that on the average a single water course, or perhaps two water courses, will drain an area of about 0.75 square miles. In a drainage basin of 381 square miles there will be on the average at least fifty or more tributaries or watersheds comparable to the Nepper. If the planning is carried out under the present legislation which confines the program to a drainage area of 381 square miles, it is likely that the highest net annual benefits for a given investment will be yielded by a plan in which the maximum possible drainage area has been considered. There is, however, no particular reason for confining the program to a watershed. Hart[4] has made a similar point. A single county in Iowa or other larger civil or geographic unit could very well be used.

The argument for the use of a planning unit larger than a watershed would be weaker where a substantial proportion of benefits are off-site. However, the authors indicate that of the $9,668 total net benefits in the Nepper watershed, $9,449 are benefits to farmers. The remaining $219 are off-site public and downstream benefits. Thus, 98 per cent of the benefits are to the farmers. Where such is the case, it would appear that the use of the watershed as a unit of appropriation or planning reduces the probability that the program will provide maximum utilization of the available funds. This result is not automatic inasmuch as the unit of planning need not be the unit of action. On the other hand, watershed programs require active local participation and cooperation for initiation and action, a condition which in practice can be expected to tie the program of action to the planning area.

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[3] Horton, R. E., "Erosional development of streams and their drainage basins: hydrophysical approach to quantitative morphology," *Geol. Soc. Amer. Bull.*, 56:275-370.

[4] Hart, H. C., *The Dark Missouri*, Univ. of Wisconsin Press, Madison, 1957, 260 pp.; p. 191.

ON VARIANCE ESTIMATE OF MARGINAL PRODUCTIVITY

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SOME comment on "Computation of Variance Estimates for Marginal Physical Products and Marginal Rates of Substitution" by Doll, Jebe, and Munson (August issue of this *Journal*) seems in order, just in case someone should attempt to apply their formula to calculate variance estimates for marginal physical products of any production function obtained by means of the least squares method.

The authors stated that "the method presented is generally applicable to any study involving least squares regression methods." This statement needs to be qualified because there is an important exception to their claim. Their variance formula can be applied only to those cases where marginal physical product functions are linear combinations of estimated regression coefficients. If the marginal physical product cannot be expressed as a linear function of the coefficients, the formula is not the appropriate one to use. For instance, consider the case of the Cobb-Douglas production function. It is perhaps one of the most frequently used mathematical functions for productivity studies relating values of input and output. It is well known that parameters of this type of production function can be estimated by first transforming observations on input and output variables into their logarithms and then applying the familiar least squares technique. Let a single-input Cobb-Douglas function be $Y = a X^b$ where a and b are the coefficients estimated by the least squares method. The marginal physical productivity evaluated at, say, $X = x$ is

$$\frac{dY}{dX} = abx^{b-1}.$$

Clearly this is not a linear function of a and b, and one cannot apply the formula proposed by Doll *et al.* It should be noted that Carter and Hartley had derived a variance formula for this type of marginal productivity and their result was presented in the April issue of *Econometrica*, 1958.

In the appendix of their paper, Doll *et al.*, demonstrated a derivation of an expression for the variance of the function L which is a linear function of some random variables. It seems to me that this fact should be explicitly noted in their introductory as well as summary remarks.

REPLY TO JOHN LU

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THE procedures presented in our paper are applicable only to least squares estimation equations linear in the unknown parameters. While we attempted to mention wherever appropriate that the equations we were using were linear, we never specifically mentioned linearity as a prerequisite. Mr. Lu has clarified this—however, we doubt that careful readers would be misled by the article as it stands.

The use of transformations in statistical procedures leads to a number of considerations that we did not wish to deal with in our article. Readers who prefer the Cobb-Douglas equation, or other exponential equations involving logarithmic transformations, would be interested in the work of J. Neyman and E. L. Scott, "Correction for Bias Introduced by a Transformation of Variables," *Annals of Mathematical Statistics,* 31:643-55, 1960, as well as the article by Carter and Hartley.

PROCEEDINGS PAPERS, WINTER MEETINGS

American Farm Economic Association

AND

Allied Social Science Associations

St. Louis, December 27-30, 1960

THE ROLE OF AGRICULTURE IN THE WORLD ECONOMY

CHAIRMAN: SHERWOOD O. BERG, UNIVERSITY OF MINNESOTA

PROBLEMS OF INCREASING AGRICULTURAL PRODUCTIVITY IN LESS ADVANCED COUNTRIES

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WHEN assigned a paper dealing with anything about productivity, I inevitably spend a greater amount of time thinking about terminology than about component parts. To obviate this dilemma here I have first outlined what may be an unnecessarily lengthy statement on "Definition and Measurement." Having done this cathartic exercise, I proceed to what seems a logical sequence of general categories which deal with human and institutional problems in agriculture, problems of the resource base, and finally to problems of technique and knowledge.

Problems in Definition and Measurement

The practitioners of our profession seem reluctant to specify a unique set of conditions, organizations, and circumstances under which productivity in agriculture would be maximized. This reluctance is, of course, understandable if for no other reason than that agriculture is but one sector of a socio-economic system.[1] But there are other reasons. Perhaps the principal of these is the complexity of interpersonal comparisons and the total lack of a reliable index in utility measurement. Then there is the even broader problem of defining productivity goals in any objective sense.

Productivity, in my way of thinking, is a relative concept by which two situations may be compared, or possibly by which some given situation may be compared to an ideal. Specifically, productivity can be thought of in terms of input-output ratios, and a productive agricultural system will be one which yields a greater output for a given input. In this context the most productive agricultural situation is that which maximizes the output for a given input, or minimizes the input for a given output.[2]

Next, it is necessary that we understand the difficulties inherent in de-

[1] Furthermore, Domar has pointed out that none of the basic structural segments of a society could be properly taken as an independent variable in a system of simultaneous relationships without great complexity. See E. D. Domar, "Economic Growth: An Econometric Approach," *Am. Econ. Rev.*, 42:481, May 1952.

[2] This is the economic efficiency concept as used by most agricultural economists; for example, R. G. Bressler's work on marketing efficiency at the University of California.

fining goals and measuring the degree of success in achieving these goals through yardsticks of qualitative phenomena. I shall list a few of the specific limitations with respect to goals in relation to the concept of productivity stated above.

1. Since many alternative products and many factors of production are involved in any agricultural situation, the process of value homogenization (welfare indexes) on the product side and the substitutability question on the factor side raise formidable measurement problems.

2. Prices with which we might weight our factors and products are subject to changes and cyclical fluctuations. Moreover, in less advanced countries the pricing mechanism is usually extremely inefficient.

3. If we obtain an economic measure of productivity in agriculture based on income generated in that sector, it may tell us very little about the standards of living and welfare because of the problems of noncommercial production, population growth, and certain subjective values.

4. Productivity may be "high" because of some sort of geographical or climatological determinism, but "low" with respect to the input-output relationship of human effort.

5. Increases in per capita output or income in agriculture may result from such things as changes in the length or intensity of the working period or in the ratio of agricultural labor force to the total labor force.

6. Even if we reduce measurement to man-hour productivity in agriculture, we still must consider the productivity per unit of other factors. Moreover, there is the problem of disguised unemployment which must be considered.

7. Physical measurement of productivity over time is further limited by the interrelationship of cause and effect between input and output, i.e., "causes" of low productivity in agriculture can also be its "effects."

Any solution to the definition and measurement problem, though it attempts to allow for discrepancies between productivity and general welfare objectives, must still take account of that complicating factor, the human evaluator. Human beings are both productive agents and the "ends" of productive effort. Although we have strong convictions relative to the correlation between agricultural productivity and welfare objectives, i.e., that increased productivity in our terms is consistent with generally accepted goals of society, it may be dangerous from a policy viewpoint to accept this presupposition regarding productivity. If achieving higher productivity means comprehensive changes in physical environment, political structure, educational methods, legal framework and incentives, a society may choose less productivity.

In light of what has been said, we conclude that agricultural productivity as well as total economic activity is but one aspect of welfare, albeit an important aspect. Moreover, there are instances in which maximizing

total output is likely to be a more crucial objective than maximizing productivity with respect to some one factor, e.g., productivity per man-hour.[3] Finally, although the concept of agricultural productivity is difficult to define precisely, the difficulty should, in itself, not be an obstacle to attempts at measurement. We pass now to the problems of increasing agricultural productivity in less advanced countries in this definitional context.

Human, Ideological, and Institutional Problems

An outstanding Indian economist has stated that economic reorganization and increased productivity "... should be in accord with the character, tradition and genius of Indian rural society, and should at the same time lead, over a period of years, to economic efficiency, social justice and democratic freedom."[4] This, in a nutshell, is what must be done in any less advanced country, but therein is the rub. Reform and improvement in agricultural production must usually be carried out against almost insurmountable forces of social inertia.

It is my firm belief that some of the greatest obstacles to increased productivity lie in the area of cultural, institutional, and community conditions.[5] Altering the willingness of farm people to respond and converting them to receptive attitudes should be closely combined with, and may even precede, programs which would change their mechanical ability to perform. Certainly these changes must be made before large-scale technical programs are introduced. By receptivity I do not mean simple acceptance of methods of performance or modes of activity which are new but proven and which will, of themselves, enhance production. Instead, the notion of receptivity is better correlated to attitudes which relate to such things as material values, incentives, advancement, etc. The contemplative, nonexperimental, incurious and fatalistic outlook of large sectors of the rural population of India, and even certain of the intelligentsia, typifies an attitude. Such attitudes no doubt account for the absence of skill in husbandry and the low level of productivity in Indian agriculture; but they dictate to some degree the elasticity of response of agricultural producers in every country.

The most serious aspect of this entire matter is the reluctance by all concerned to discuss, to analyze and face up to the necessary changes in ideologies and institutions in order to increase over-all productivity. The literature is quite deficient on the subject, especially in those environs where attitudes and modes of conduct run strong. In an attempt to minimize the scope of adjustment to new knowledge or different ideas, Occi-

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[3] For example, when labor is plentiful and land scarce.

[4] Tarlok Singh, *Poverty and Social Change*, Longmans, Green and Co., 1945, p. 194.

[5] There is reason to believe that purely economic explanations of productivity and growth are futile. See the excellent article by E. E. Hagen entitled "Turning Parameters into Variables," *Am. Econ. Rev.*, 50:623-29, May 1960.

dental technologists have played down the necessity to change thought patterns, value systems, cultural notions and the like. Our actions in this regard are ostensibly apologetic for the ruthless way in which local tradition and custom were ignored in the past. But now, in the name of cultural freedom, we seem to have ignored the fact that any society is a series of interrelated factors, few of which can be changed without altering others. Needless to say, this is applicable to the agricultural sector.

This is no plea for some sort of neo-colonialism through technical assistance programs. We should not expect agriculture and rural development to follow the same pattern as, say, in the United States. (We may have implied as much by such a big dosage of our land-grant college system to foreign countries.) Nor should we expect replicas of Western communities. It must be remembered, however, that elements of basic values must be imported in underdeveloped areas along with techniques if increases in agricultural production are to be harmonized with industrial development. Desires for efficiency and material advance, and inclinations toward rationalism, experimentalism, and enterprise must be cultivated. These areas will also have to instill respect for the principle of the rule of law and stamp out arbitrariness, corruption, and inefficiency in public office.[6]

Improving the human agent in agriculture

Productivity in agriculture may be improved by attending to both the physical and other needs of human beings who compose the labor factor. One of the places where the vicious circle of poverty and low productivity can be broken is through better diets and nutrition; but care must be taken that food and nutrition programs don't just "feed the worms." Getting rid of worms, parasites, and disease is equivalent to a substantial increase in the food supply; hence health programs play a vital role in increasing productivity.[7]

Education is the most universally prescribed remedy for increasing the capabilities of the human agent in underdeveloped areas. I should like to make two observations about education as related to agricultural productivity, both of which may be subject to biases that reflect personal experience. First, schooling in many countries tends toward a formal, verbal, and academic emphasis, with an undue amount of professional training. The goal of such training is likely to be the acquision of techniques rather than the spirit of learning which produced the techniques. Learning by verbal instruction and rote memory is put ahead of libraries, laboratories, and research programs in the physical, biological, and social sciences.

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[6] Gunnar Myrdal, *An International Economy*, Harper and Brothers, 1955. See Chapter XIII, "National Integration in the Underdeveloped Economics," pp. 167-221.

[7] H. Belshaw, Address given before the Auckland Branch of the Economic Society of Australia and New Zealand, Aug. 1951.

Needed is education in the nature and form of inquiry—seeking, rather than receiving knowledge. Chester Hunt has cited the Philippines as a prime example of this problem with the second highest proportion of college students in the world, the greatest number of lawyers of any country in the Pacific area, and the lowest rice production in the Orient.[8]

Brazil is a typical Latin American example of this educational tendency. In the twelve colleges of agriculture in that huge country, several of which are first-class institutions, less than two hundred employable graduates in agriculture are produced annually. Compare this to thousands of lawyers, political scientists, and economists. The system and spirit of learning in agricultural colleges is conducive to professionalism more than to augmenting agricultural productivity. It perhaps is significant to note that no farm management or marketing text of consequence has been produced by a native author for use under Latin American conditions.

The second observation on education and agricultural productivity relates to the role which United States attitudes and institutions are playing in the scheme of things. We are in a sense aggravating the problem by attempting to make high-powered analysts and development economists out of far too many agricultural and run-of-the-mill people. Let me be specific. In the case of Brazil, there is a dire need for elementary training in farm accounting and management techniques of research. What have we done in many of our recommendations but send Brazilians and others to schools which plunge them immediately into advanced courses in production economics or the like, to receive training which in many cases is not only inappropriate but is also noncommunicable to those in need back home? Then there is the ubiquitous short course in economic growth or economic development held periodically by various national and international agencies, the value of which is questionable for agricultural economists in such areas.

Wide use of extension methods is absolutely necessary if formal training is to result in an increase in productivity. And where illiteracy prevails, films, radio, informal group discussions, and demonstrations under local conditions must be utilized.

Land reform

The concentration of land ownership and control, the system of large estates, the separation of agricultural society into the small class of elite and the mass at the other end of the scale, absenteeism, and local political control by landlords—all these have meant low productivity, low living standards, obstacles to expanding markets and deterrents to industrial growth. It is of great importance that in countries where land

[8] Chester L. Hunt, "Cultural Barriers to Point Four," *The Antioch Review*, 14:159-67, Summer 1954.

ownership is divorced from cultivation, land is an object for speculation and investment by a tiny class of people at the top. Consequently, land becomes a symbol of power, prestige, and wealth, and speculation in land becomes a deterrent to industrial growth.

Because of the dominance of agriculture in the economies of underdeveloped countries—which is, in itself, indicative of underdevelopment—a land reform program is usually high on the list in plans to increase productivity. Unfortunately, the need for some constructive measures with respect to man's rights in land has been lost in slogans and emotionally conceived programs of confiscation which would expropriate, break up, and redistribute large land holdings. This is the all in all of land reform to many, *coûté que coûté.*

Redistribution of rights in land may in the short run reduce productivity due to the lack of experience and capital of the new entrepreneur. It will almost always reduce temporarily the marketable surplus in agriculture, and in extreme cases, such as the Russian experience, may result in widespread hardship and starvation.

Land reform programs, therefore, must be combined with a broad attack on other institutional fronts in order to meet the objectives of development needs. Raup emphasizes that land reform as such is no panacea.

> It can be a sterile and debilitating experience if carried out in a narrow setting, without the support of other reforms in systems of education, extension, credit, and taxation. It can build upon or it can dissipate the political strength inherent in programs that can generate high levels of emotion and national effort.[9]

He suggests[10] that in its broader context land reform should be thought of in terms of land tenure reform and should include two types of measures:

1. *Measures directly involving the tenure under which land is held:*
   - (a) The promotion of ownership by the operator and the reduction of absentee landlordism.
   - (b) The regulation of rental rates and practices, and the enactment of lease protection laws.
   - (c) The consolidation into efficient-sized units of strip parcels and scattered holdings.
   - (d) The subdivision of large holdings.
   - (e) The control of land inheritance to prevent excessive subdivision of holdings, or to discourage the accumulation of large holdings.
   - (f) The improvement of land surveys and systems of title registration.

[9] Philip M. Raup, "The Contributions of Land Reforms and Agricultural Development: An Analytical Framework," Social Science Research Council Conference on the Relation between Agriculture and Economic Growth, Stanford University, Nov. 11-12, 1960, p. 48.

[10] *Ibid.*, p. 6.

2. *Related measures essential to the success of land tenure improvements:*
   (a) The development of an effective agricultural extension service.
   (b) Improvement in commercial and cooperative marketing systems in circumstances in which the structure of land ownership dominates or restricts the market outlets for products of land.
   (c) Improvement in the conditions of agricultural labor under tenure systems in which land ownership includes some claim to the services of people living on the land.
   (d) Improvement in the agricultural credit structure in circumstances in which inadequate credit is a barrier to tenure reform.
   (e) Improvement in the arrangements under which land is bought and sold.
   (f) Reform in land tax and fiscal policies.

With all this I agree and would add another economic fact and one generality. The fact is that when farmers are freed from the strictures of land strategy in particular situations they (or someone) have to make up for—in taxes, perhaps—the savings of the formerly rich landowners. The generality: land reform is a serious step in the internal struggle for power and wealth of most underdeveloped countries and must be treated first and foremost as a political problem and adjusted to social conditions and value systems existing in the different countries and areas of the world.

Market organization

Much less attention has been given to the role of product markets in agricultural productivity than to such matters as land reform, agricultural credit, improved technology and factor supply. Professor Mehren outlined some hypotheses on market organization in a paper before this Association in 1959.[11] These ideas were extended further in a paper which appeared recently.[12] Some valuable items appear in the latter contribution under the headings "Suggestions" and "Propositions." I am particularly impressed with Mehren's bibliography!

It is apparent to those who have had the opportunity to observe conditions first hand that productivity will not be increased by grafting a modern market structure to peasant-type production units, and that archaic market conditions and market structures may, in fact, be efficient with respect to existing production organization. Many of us have seen the rotting remnants of canneries, warehouses, cold storage plants, milk bottling depots, forced upon unready economies without either suppliers or customers able to use them.[13] It is also apparent that farm production is not predominantly market oriented in less advanced countries, and fur-

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[11] George L. Mehren, "Market Organization and Economic Development," *J. Farm Econ.*, 41:1307-15, Dec. 1959.

[12] George L. Mehren, "The Contribution of Industrial Development to Agricultural Development: Emphasis on Products Markets," Social Science Research Council Conference, *op. cit.*

[13] *Ibid.*, p. 30 of the paper.

ther, that changes in food and nonfood agricultural markets will probably have to be induced from changes in general economic buying power. Certainly without a condition which enchances market growth there is little opportunity—and little need—to attempt to increase productivity.

Two things should be said about monopolistic market conditions and their relation to agricultural productivity. In the first place, such structures may be desirable, given the producer and consumer units with which they must deal. Hugh Cook suggests that monopoly may be one price of self-sufficiency for those countries in which markets are small (both populationwise and in terms of purchasing power); and that both monopoly and self-sufficiency may be "good" if they produce a type of integration which will circumvent the high social costs of market services.[14] But this should not be taken to mean that monopoloid conditions enhance either effective resource allocation or the use of techniques. Quite the contrary may be the case.[15]

The second thing about monopoly is this: state intervention in the market system must recognize the interdependence of functional segments in agriculture and the close relationship of agricultural market development to over-all economic development. For example, commercial channels for processing and distribution of cash crops appear to be essential to capital formation in agriculture. Statutes should permit and encourage this. Care must be taken, however, that state monopoly or administrative mandates do not arise to inhibit development of improvements in the exchange economy. In many cases the maintenance of small scale distributive monopolies has maintained the small scale productive structure and the inefficiency of primitive agriculture.

I should like also to pay passing attention to the problem of price stabilization. Price fluctuation is particularly severe in underdeveloped countries. This can only adversely influence agricultural productivity. Unless there is confidence that product prices will have a minimum relationship to costs, farmers will be hesitant to incur necessary expenses to increase output. Further, price instability is increased by the subsistence character of agricultural production. To allay the impact of this instability, governments have designed measures to minimize price fluctuations, with varying success.[16] There are many obstacles to the success of such measures, of which the main ones are the lack of administrative machinery, lack of operating funds, shortage of marketing and storage facilities, poor transport systems, and the heavy dependence of many products on the export market.

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[14] Hugh Cook, "Market Structures and Economic Development in the Philippines," *J. Farm Econ.*, 41:1321, Dec. 1959.

[15] Guiseppe Orlando, "Agricultural Marketing and the Italian Economy," *J. Marketing*, 21:327-8, Jan. 1957.

[16] FAO, *The State of Food and Agriculture, 1959*, Rome, 1959, pp. 137-41.

Problems with Respect to the Resource Base

When we examine further the question at issue, it is evident that other matters may be at the root of low productivity per head or per manhour in agriculture. Certain of these I shall refer to as resource deficiencies, for the lack of better terminology. These deficiencies are of two types. First, there is the low ratio of natural resources to population which prevails in many countries, as is the case with much of southeast Asia; second, but no less important, is the limiting factor of capital and organization, good examples of which are found in Central Africa and parts of Latin America. Typical of most underdeveloped areas is the small-sized holding which is cultivated with primitive tools by ancient methods and where no capital is being generated to alter the situation.

The man-land complex

One can detect in the literature a difference of interpretation as to the significance to productivity of a low ratio of land resources to people. For example, Belshaw states, "There is a rough, but striking relationship between area per worker and productivity per head and, therefore, the surplus available for nonfarming populations."[17] He proceeds to cite Colin Clark's study on agricultural productivity in New Zealand, Japan, and southeast Asia to substantiate the thesis that there is a strong relationship between greater land resource availability and per capita output. With a seemingly contrary view the FAO states that:

> There appears to be rather little correlation between the level of agricultural incomes (productivity) and the average size of farms in the countries. . . . It is true that some of the high income countries are sparsely settled with a large area of agricultural land per man, and that the countries where farm incomes are lowest have congested agricultural population and very small farms. But the contrast between countries which have more or less the same area of agricultural land per man are so striking that *not too much importance can be attached to the physical area.*[18]

The apparent divergence of conclusions found in these studies may be reconciled by pointing out that where the physical limits of land expansion have been reached and in countries where farms are small, farm income (productivity) is limited by these factors.

The Belshaw-Clark statement, however, can be admitted only in some *ceteris paribus* and theoretical condition of static technology. While the FAO study admits that a rising farm population and an increasing subdivision of holdings may impede productivity,[19] evidence to the contrary is plentiful, especially in those circumstances which permit full utilization

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[17] H. Belshaw, *op cit.*
[18] FAO, *op. cit.*, p. 122. Words in parentheses and italics are mine.
[19] *Ibid.*, p. 123.

of technology and knowledge and processes for their dissemination.

While production has been increasing in most countries at a faster rate than has area of cultivated land, and, in some industrialized countries, even in spite of a contraction in agricultural area, this is no reason to halt efforts to improve the ratio of land resources to people. International and even intranational migration offers no real solution, and increasing the land resource in itself is no easy task.[20]

But in most countries additional land can be brought under cultivation or cultivated more intensively or more scientifically. Irrigation, drainage, flood control, reforestation, soil conservation and other measures, assisted by better farm management, more appropriate layout and structure of holdings and modern technology of agriculture can greatly increase the productive potential.

Capital formation and credit

Capital for investment in agriculture is one of the least plentiful and most limiting resources in underdeveloped countries. The economist's interest in land reform, for example, derives from his interest in a higher rate of agricultural capital formation, which is a necessary precondition for expanded output. Raup has observed that capital in farming is rarely concentrated in a spatial sense, and its formation is heavily weighted by the time dimension, accumulating by an incremental process which he labels accretionary.[21] It follows that a country's tenure system will constitute a major force in maximizing the formation of capital in agriculture as well as in influencing the reinvestment of any surplus above subsistence levels in the productive plant.

Increased private capital investment for agriculture would also be forthcoming if measures were taken to stabilize farm prices and improve marketing methods and facilities. Money that is now hoarded in many forms or used for land speculation due to market instability could be spent on fertilizers, better seeds, livestock, insect and disease control, and other measures to increase productivity. The FAO study suggests that the establishments of savings banks in rural areas appears to be a good way to tap local savings, which they estimate to be substantial in some areas, for use in agricultural production.[22]

Public extension of credit to increase productivity in most less developed countries is necessitated by the fact that small farmers have little or no access to institutional credit. Private credit can be obtained from

[20] There is some difference of economic prognosis in this field also. I am thinking primarily of Stamp's conclusions and those of Pawley, et al. See: L. D. Stamp, *Land for Tomorrow,* Indiana Univ. Press, Chap. III; and W. H. Pawley, et al., "Possibilities of Increasing the Supply of Food and Agricultural Products by Exploitation of New Areas and Increasing Yields," *World Population Conference,* Rome, 1953.

[21] Raup, *op. cit.,* p. 13.

[22] FAO, *op. cit.,* p. 153.

relatives, landlords, merchants, and money lenders only at usurious rates of interest. And since cooperative movements have made little impact on the provision of agricultural credit in these countries, government agencies provide credit of one kind or another. For example, in Chile, the Agricultural Department of the State Bank supplies fertilizers, seeds, pesticides, etc., on loan to farmers at low interest rates.

A very important matter in the use of credit is the emergence of concepts that relate debt repayment ability to increased output. Supervised credit has been instrumental in putting this whole matter in perspective, though it is by no means the answer to the entire credit problem. Wharton, in his sound analysis of supervised credit in the municipios of Corvelo and Uba, State of Minas Gerais, Brazil, found that the supervised credit "program was partly responsible for the observed changes in output and productive efficiency."[23] The most dramatic aspects of these results were that positive changes in output and efficiency took place in one of these areas despite adverse weather during a five-year period.

Improvements in the ratio of resources to people and the increases in the quantity of capital are not sufficient to assure increased productivity. A recent authoritative study concluded that agricultural credit in the great majority of underdeveloped countries has brought no net increase in output and no increase in the income and assets of the peasant.[24] The principal blame for this static situation is placed upon failure to stress qualitative improvements and qualitative effects, i.e., dynamic credit use. Lack of innovations, that omnibus term, seems to be the main reason. A wide range of meanings is covered by that term, some of which have already been touched upon; for example, changes in attitude, and improvements in insitutions and social and economic organization.

It remains for us to explore knowledge and technology and their extension as important cogs in the wheel of increasing productivity.

Problems Related to Knowledge and Technical Improvement

The most fashionable of the proposed methods to increase productivity in backward agricultural areas is the technical assistance program. It had become fashionable even before President Truman's address, especially among thousands of missionaries of rationality, experimentation, economic and social advance, and a generally better life. And it is one thing which almost everyone is "for" and which, ideologically speaking, runs into little opposition.

But there is further agreement in the field of technology and knowledge, especially among those who have been part of working aid programs. I

[23] Clifton R. Wharton, "The Economic Impact of Technical Assistance: A Brazilian Case Study," *J. Farm Econ.*, 42:226, May 1960.

[24] H. Belshaw, *Agricultural Credit in Underdeveloped Countries,* FAO Agri. Studies, No. 46, Rome, 1949, p. 230.

speak of the impossibility of transplanting modern technology from one country to another on a large scale. As with the importation of capital, there is a limit to the absorptive capacity for technical assistance. These limits are set in part by what Hopper calls cognitive or knowledge space of individuals and the valence structure of their individual values.[25] Limits are also set by the cultural heritage. For agriculture, rural tradition of small groups and their geographic and historical patttern of civilization will weigh heavily in determining their responsiveness to new ideas, new methods, and new results.

Hence we emphasize again the principal thesis that increases in productivity will be conditioned not only by educating farmers and disseminating knowledge to them, but also by incentives which are created through environmental changes and by a willingness on the part of a rural population to absorb new ideas, skills, and techniques. Individual farmers and groups must, therefore, adjust to new patterns of production and living which in time will draw them further and further from the accustomed pattern of peasant agriculture.

There seems to be little doubt that production per capita, per man-hour and per acre in most underdeveloped countries can be greatly increased by improved practices that make use of abundant hand labor and certain types of primitive power. There is a variety of tools that constitute intermediate steps toward a mechanized agriculture, and there are endless possibilities for a greater utilization of available capital resource combinations. There is no need to detail these resources here. But reference to Cochrane's optimism and serendipity should be made.[26]

If it can be assumed that a broad front of new knowledge can be moved into the agriculture of less advanced countries (as Cochrane assumes for agriculture in the United States) there is reason to hope that output can be increased at a rate much above the rate which actually exists or which some of us expect. I am not as hopeful in the area of machines and equipment as in other forms of knowledge. These are: improved disease control, improved pest control, improved water control, new and improved varieties, upgraded labor skills, improved management skills, and other new knowledge that could be fed to those who would use it. And there is reason to believe that research and development in agricultural production of less advanced economies should benefit from external economies of scale and be fed by the fruits of research in the more basic disciplines (e.g., biochemistry, bacteriology, etc.).

The practical limitations on utilizing technical knowledge (in addition to those already explored) derive in great part from problems in devel-

[25] W. David Hopper, "Non-Economic Factors Affecting Agricultural Development," Social Science Research Council Conference, *op. cit.*, p. 10.

[26] Willard Cochrane, "Farm Technology, Foreign Surplus Disposal and Domestic Supply Control," *J. Farm Econ.*, 41:888, Dec. 1959.

oping and administering programs of assistance. These limitations were expressed in the form of problems by a National Planning Association study of technical assistance programs several years ago.[27] These problems are summarized as:

1. The absence of administrative, legislative, and financial continuity and stability.
2. Too little delegation of authority to field staffs for planning and operating the programs in host countries, but not enough technical guidance from headquarters.
3. Inadequate coordination of bilateral, multilateral, and private plans and programs.
4. Ineffective policies and procedures for recruiting, training, and retaining able personnel.

The question eventually arises as to how much of the increase in productivity can be attributed to improvements in the state of the arts as compared to the use of additional resources. There is a limited literature on this subject. Clarence Moore, in a study of the agriculture inputs of Mexico from 1945 to 1949, found that of a 60 per cent increase in output, 34 per cent could be attributed to better techniques that improved productiveness of resources in the aggregate.[28] Certainly more evaluative studies should be made to determine the quantitative as well as the qualitative effects of efforts to change techniques and to increase knowledge.

Concluding Remarks

The following sentences seem appropriate as a conclusion. To discover some determinants of potential agricultural productivity and to discover conditions under which productivity *is actually* increased and effective are two different matters. Othodox theory is most at home in analyzing the productivity response when the various factors are combined under a situation of scarcity. But what we encounter in the agriculture of many underdeveloped countries is not always orthodox. We do encounter what I call a *set of opportunities* which are embodied in the resources, the labor, the existing capital and the potentially usuable knowledge. But these, of themselves, do not spell increased productivity. I posit that such things as enterprise, institutional disparities, and attitudes toward private and social production—all these factors, which are not incorporated in traditional theory and current growth models—will in the last analysis influence agricultural productivity, for better or for worse, more than will the so-called *set of opportunities.*

[27] National Planning Association, *Technical Cooperation in Latin America—Recommendations for the Future,* June 1956, p. 6.

[28] Clarence A. Moore, "Agricultural Development in Mexico," *J. Farm Econ.,* 38: 72-80, Feb. 1955.

CAPITAL FORMATION: PAST AND PRESENT[*]

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THE role of capital formation as an integral part of the process of economic development is widely recognized. Though various criteria for the proper allocation of capital between sectors over time and in aggregate amount have been suggested, the basis for within-sector decisions has not always been clear and, in practice, sometimes tends to be oriented financially with narrow cost-benefit analysis. We attempt here a brief exploration of some relevant criteria as a guide to capital investment in the agricultural sector at various stages in the development process. For this purpose we accept the concept that development—an increase in per capita productivity—is good. We recognize that the process involves a redistribution of assets, shifts in political power, and a restructuring of social goals and relationships. We assume that as a society attempts to mitigate these effects it does so within a framework of continued development. Thus our paper is directed at the question of how capital investment in agriculture should be formed and allocated so as to best implement continued agricultural development.

Structure and Capital Formation as Seen in the Past

An historical review of capital formation in agriculture leads to the conclusion that differences in organization and market orientation affect the process. It is relevant to compare capital formation within the firm or unit of production in commercial agriculture (both foreign and domestically oriented) with that in the subsistence or near subsistence sector. This in turn contrasts with capital formation, both public and private, outside the farm firm. The "commercial" and "subsistence" sector, though in practice not rigidly separable, differ in methods of capital formation. This application is consistent with the historical development of United States agriculture except that the extreme subsistence sector, such as in the dual economies of Southeast Asia, does not appear.[1]

The investment of liquid capital in underdeveloped countries, i.e. saving out of income or borrowing, has been confined primarily to a relatively small commercial sector producing for export or for the domestic non-farm market. Within this *commercial sector* itself, distinctions need to be made by types of organization and their derivation.

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[*] Journal article no. 2740 from the Michigan Agric. Exp. Station.

[**] In developing our ideas we have benefited from the comments of J. T. Bonnen, P. Foster, D. E. Hathaway, G. L. Johnson, R. A. Loomis, L. V. Manderscheid, and J. D. Shaffer.

[1] See J. H. Boeke, *Economics and Economic Policy in Dual Societies,* Institute of Pacific Relations, New York, 1953.

First, there existed and still exists the foreign enterprise, a "plantation system" of organization closely related to the product markets and marketing services engaged in international trade. The plantation system was essentially foreign—dominated by European enterprise and capital with extensive European trading connections. Capital borrowing, technology and market demands were similarly oriented. While clearly evident in the early history of the Western Hemisphere, its recent main focus has been in Asia and Africa; in the Far East, it was supplemented by Chinese and Indian enterprise.

A second system of productive organization, sometimes as a stage in the evolutionary process, was the indigenous "latifundia." While having structural forms closely related to the medieval manor, they are most common in production for export in numerous countries, particularly in Latin America. Developing at a time and situation in which land was plentiful, the latifundia were large-scale in terms of land, but represented a considerably less intensive utilization of liquid capital investment and entrepreneurial ability than did the plantation system. They did not have as close and intimate a connection with the product market, the capital market, or with sources of technology; hence capital formation was more limited. This system of organization dominated the cattle industry in South America, coffee in Brazil, cocoa in Ecuador, Venezuela and Trinidad, sugar cane in the Caribbean, etc. Many of these organizations continue in existence.

A third distinct system of commercial enterprise was that of the small-scale, indigenous native producer which emerged out of the subsistence sector and which maintained intimate connections with it. Here investment of liquid capital was small, in many cases to the point of insignificance, and traditional pre-scientific methods of production invariably were followed. Both social and geographic distance played a part, as did the psychological attitudes of producers only slightly removed from subsistence production. Small-scale native enterprise developed the cocoa industry in Brazil and West Africa, a considerable part of the rubber industry in Malaya and Indonesia, coconut production in the Far East, etc.

A *subsistence sector*, distinct from the commercial sector in its production orientation and method of capital formation, is a characteristic of underdeveloped agriculture. This distinction cannot be sharply made in practice as there have existed a series of gradations from the native producer operating heavily in the commercial market to the almost completely isolated rural village community. The distinction, therefore, is one of degree; it would be difficult in most countries today to find a community which did not have some commercial connection, however small.

As regards capital formation the distinctive character of the subsistence sector is the manner in which the formation took place rather than its

absence. In fact one may make a good case for the existence of a considerable quantity of invested capital in the subsistence sector. The important point is that the formation process involved mainly the utilization of seasonally unemployed, but not necessarily redundant labor. Thus saving out of income, borrowing and concern with the external capital market was not of primary importance. The strategic factor in determining the level of capital formation was the equation of overall, long-term food and fiber needs of the farm family, and thus of the rural population in general, with additional effort in land improvement, water control installations, etc., required in production.

It needs to be emphasized that this process of direct, labor-induced capital formation characterized not only the primarily subsistence sector but also the small-scale native commercial producer, and it even flowed over into the latifundia type of organization. These two processes of capital formation were not distinct; it was a question of gradation.

A final area of capital formation existed in the public sector. Here investment was financed out of budgetary surpluses or by borrowing, although in many areas considerable construction was undertaken under the corvée system of taxation involving the direct supply of labor in road construction and other forms of public works. Even the latifundia in some cases incorporated this system as a way of making "community" investments.

The existence of a commercial and a subsistence sector with varying gradations, a public sector and two distinct types of capital formation with different investment criteria, raises the question of the appropriateness of the resulting pattern of capital formation. Although in both commercial and subsistence sectors allocation may proceed on rational lines, the criteria are different. They are not necessarily intermeshed or interchangeable in the sense that if only one criterion were present the same pattern of capital investment would emerge.

In the commercial sector, moreover, the process of capital formation was divided into a series of poorly interrelated sections. Plantation investment was induced from outside the local economy and related more to international allocation conditions than to purely local ones; also, in the local sphere usually only one or two commodities had the necessary comparative advantage to enable them to compete on world markets.[2] Hence plantation investment was narrowly concentrated.

In the indigenous commercial sector the low liquid capital investment reflected a plenitude of labor and a scarcity of capital, as revealed in low wages and high interest rates,[3] and an insufficient supply of technical and

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[2] And local banks made loans on such specific crops.

[3] But not sufficiently high as to discourage a considerable volume of consumption loans.

entrepreneurial ability necessary to obtain an adequate return on invested capital. Owners of latifundia tended to keep investment low, to make the enterprise more self-sufficient so as to restrict cash outlays, and to use surplus funds either in land speculation or in non-farm investment, such as real estate, which provided a high return without a high level of managerial talent. Labor was used in place of capital wherever possible and maintenance of old equipment was carried to great lengths.

Investment in the public sector also was uneven with a tendency to invest in the infrastructure (roads, dams, communications, etc.) as compared with social overhead (education, research, extension services). The latter is largely an investment in the human agent. This constituted a serious bottleneck to private commercial investment outside the plantation section, since indigenous organization required for its fulfillment such basic social investments. Also public investment has been somewhat lopsided in that it concentrated on "ad hoc" projects involving public works but loosely integrated into the economy. For instance, attention was directed to transportation and multipurpose projects to the exclusion of product and factor markets. A reasonable explanation of this would be that these sections were considered to be integral parts of the private sector. In fact, however, they were not always sufficiently well developed privately in relation to specific projects or final markets. There thus existed in the commercial sector at least, scope for better investment allocation.

Implication for the Present and Future

Since World War II certain changes in the political and social scene have influenced the volume and direction of capital formation. First, the plantation and latifundia systems have receded in importance as they have become unpopular politically; the focus in agricultural development is now on the small-scale producer.[4] Second, with the rise of nationalism and national development programs and the consequent growth in the indigenous non-farm sector, international markets are becoming of relatively less consequence on the development scene. Yet certain characteristics of capital formation in the past, outlined above, appear useful guides for present and future policy. The remainder of this paper will briefly explore such possibilities. The strategic positive factors likely to influence the form and content of capital formation in future are the rate of growth in the non-farm sector of local economies, the overall rate of growth in population, particularly in the rural sector, the presence or absence of unused natural resources, and of a subsistence sector.

It is suggested that three stages in the process of agricultural and gen-

[4] This does not exclude the possibility of government-sponsored, large-scale schemes of a plantation type or the incorporation of small-scale producers into "cooperatives" or even "collective farms" and "communes."

eral development may be distinguished. Stage I would represent the least developed, with a small non-farm sector and a large agricultural sector in which the subsistence section would predominate. There would exist unused agricultural resources and the possibility of increased output through the additional application of labor with no change in the level of technology. Stage II differs from Stage I in that there would be little or no unused natural resources to tap and little possiblity to increase output by additional labor inputs unless changes in the level of technology took place. In Stage III agriculture and general economic development would have reached a level involving the disappearance of the subsistence sector into the commercial sector with no unused natural resources but a relatively higher level of agricultural technology.

In all three stages, the growth in the non-farm sector is the key to the development of commercial agriculture, apart from the international market. It represents a governor or control over the rate of growth in demand for agricultural commodities and is a market for unskilled rural labor. Thus it influences changes in the agricultural sector from two directions. Conversely the agricultural sector stands as a major market for the products of the non-farm sector, first for consumer goods and later for increasing amounts of agricultural inputs. In addition, agriculture may provide important exports and sources of foreign exchange useful in national capital formation and in payment for imported tools for development.[5]

On the other hand, population growth well may act as a destimulant to agricultural development. In most underdeveloped countries the proportion of rural agricultural population represents 60 to 80 per cent of the total population compared with under 40 per cent in more developed countries. The subsistence sector bulks large in such rural economies. Moreover, the population growth rate in this subsistence sector appears, in most countries, to be increasing. The development of public health measures, as distinct from private health measures, in underdeveloped countries is probably the most conspicuous example of success in the adoption of western techniques. The result is that labor as a resource is expanding at a rate equal to, if not higher than, capital formation in a number of countries and thus renders the problem of development more difficult except in underpopulated countries.[6]

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[5] For a fuller discussion of this topic see Bruce Johnston, "Agricultural Development and Economic Transformation" and Witt's comments on his paper, Conference on Relation Between Agriculture and Economic Growth, sponsored by Social Science Research Council at Stanford University, Nov. 1960.

[6] The importance of the relation between population growth and the rate of nonfarm expansion for the agricultural sector is developed by F. Dovring, "The Share of Agriculture in a Growing Population," *F.A.O. Monthly Bulletin of Agricultural Economics and Statistics,* v. VIII, Aug./Sept. 1959.

Stage I: Possibilities exist for increasing production by bringing more land under cultivation and/or more labor effort using traditional methods of production, including the tradtional methods of capital formation by the investment of surplus labor.[7]

This situation may be attributable to a number of factors. First, large areas lack adequate transportation and communications, which effectively isolates them from the non-farm market. Second, transportation charges may be high enough to exclude them from market participation as returns from extra effort would not be sufficient. As transport conditions improve, the net returns to producers would increase, or as demand increases, prices would normally rise, thus extending the commercial market areas. Third, exposure to commercial market goods also may gradually change the balance between demand for goods and effort in favor of the former thus encouraging more production for the market; the extent to which such exposure can be made effective, however, depends upon the expansion of the non-farm market. Also, non-economic forces may play a part, altering the underlying values. Such factors represent functions of time which, however, are not generally predictable.

Numerous instances have occurred historically supporting these theses. Expansion in demand on local markets for agricultural products has usually been accompanied by an increase in supply in the indigenous economy through, among other ways, an increase in the commercial market periphery. Expansion in demand on world markets, such as in coffee, has resulted in the extension in the world area of coffee supply. Moreover, in the case of cocoa, areas of supply developed in Brazil and West Africa out of a previously self-sufficient economy without any other precedent than the growing desire of a society to increase its income once an opportunity presented itself.

An increased supply of commodities can be obtained for the commercial market under these circumstances without a large quantity of liquid capital investment. Capital formation will occur through the investment of labor; more effort will be expended in direct production activity on existing land or on newly developed land. Real incomes would increase directly as a result of the greater amount of labor input, even though the probability of improving technology is not high so long as labor is plentiful and investment in the public sector also is not expanded. Underlying conditions of supply would most likely approximate conditions of constant costs, or slightly rising costs where higher returns are needed to induce a larger per capita labor input and/or the utilization of poorer resources. An increasing population expands total output, a part of

[7] This discussion draws on W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labour," *The Manchester School of Economics and Social Studies*, v. XXII, No. 2, May 1954.

which represents a small individual surplus added to market supply under roughly similar conditions.[8]

Under these circumstances the opportunities for liquid capital investment in agriculture are largely restricted to the public sector for infrastructure, particularly transportation in order to expand the maket periphery. This prescription is rather distasteful and out of step with conclusions drawn from recent American experience, but largely accords with facts in a capital-scarce country. It may be concluded, therefore, that countries in Stage I are pursuing a correct policy in concentrating upon such specific aspects of the infrastructure. There is, however, much scope for further investment in the public sector, in the human agent, in social overhead particularly in education, to anticipate needs as the second stage of agricultural development is attained or to bypass it. Other investments in the public sector to enhance short-run consumption levels may be made on welfare grounds, at the expense of development or other long-run objectives.

Stage II: Population pressure on agricultural resources has reached the point where there is little opportunity to tap additional resources; marginal labor productivity is at subsistence levels or lower.[9] The subsistence sector has reached the limit of its development possibilites within its traditional technical framework. This is the situation in a number of areas in the world today. India, Pakistan, Ceylon and Java are representative in the Far East.

Two alternatives are possible. In the first the subsistence economy will of itself evolve new pre-scientific techniques through the intensification of traditional methods which will raise labor and land productivity without the investment of liquid capital. This occurred in China and Japan in the 19th century through various indigenous innovations including seed selection, the intensive use of organic fertilizer and the adoption of a garden-type cultivation.[10] The results are partly reflected, for instance, in the difference in prewar yields in India (1.35 metric tons of paddy per hectare) and China (2.52 metric tons).[11]

Such improvements in technology were achieved without any consider-

[8] "The peasant farmer of the tropics is primarily a producer of foodstuffs for personal and family needs; his production for local markets or for export is normally small. Nevertheless, the number of such farmers is so large that the sum of their modest surpluses may be substantial." V. D. Wickizer, "The Smallholder in Tropical Export-Crop Production." *Food Research Institute Studies*, 1:50, Feb. 1960.

[9] An interesting paper by N. Georgescu-Roegen discusses the institutional modifications which encourage averaging returns as marginal productivities of labor drop below subsistence, "Economic Theory and Agrarian Economics," *Oxford Economic Papers*, v. 12, No. 1, Feb. 1960.

[10] Developments in Japan are admirably described in Thomas C. Smith, *The Agrarian Origins of Modern Japan*, Stanford Univ. Press, 1959, Chap. 7.

[11] F.A.O. Production Yearbook 1956, Vol. x Part 1, page 46.

able increase in liquid capital investment. However, it is unlikely that such methods, which require considerable time for their development, will occur in countries at the present Indian level. A gradual shift to scientific agriculture will probably be adopted and incorporated into development plans.

The second alternative involves the injection of liquid capital investment in the private and the public sector.

Increasingly scholars examining this type of situation are turning to Japan as a model. Recently Thompson, Smith and Nicholls[12] have advocated that Far Eastern countries adopt Japanese development policies. This involves considerable investment in the public sector in infrastructure and, particularly at this stage, in social overhead to provide the appropriate technological climate for the neccessary complementary investment in the private sector. Such liquid capital investment in social overhead comprises: research, extension and education in the public sector, and improved tools and implements, fertilizers, commercial seed, insecticides, etc. in the private sector.

The need for a better allocation of investment than that followed by most countries, and criticized above, is apparent. The process envisages a constant shrinkage in the subsistence sector as non-farm demand expands, and a growing investment of capital complementary to land and labor engaged in agriculture. Such farm investments may result in an increase in demand for agricultural labor.[13] Moreover, the relatively high rate of expansion in population in the rural sector, such as is occurring in the underdeveloped world today, is likely to be as much as or more than the non-farm sector will be capable of absorbing.

Stage III: The subsistence sector disappears into the commercial agricultural sector. Such a situation most likely will occur only in the late stages of development. The expansion in the non-farm sector and continued growth in the demand for agricultural products will absorb a larger and larger proportion of the subsistence sector into the commercial agricultural sector and into the non-farm economy.[14] An absolute decline in the farm labor supply may occur. In any event, the cost of labor rises relative to the cost of capital and it becomes profitable to substitute capital for labor. This stage, however, is largely in the future for most underdeveloped countries.

In Japan for a considerable period of time the supply of agricultural

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[12] Warren S. Thompson, *Population and Progress in the Far East*, Univ. of Chicago Press, 1959, p. 84. Thomas C. Smith, *op. cit.* William H. Nicholls, "The Place of Agriculture in Economic Development," to be published by the International Economic Association, reporting papers presented at Gamagori, Japan, April 1960.

[13] Thomas C. Smith, *op. cit.*, p. 101.

[14] Lewis, *op. cit.*

land has remained fairly stable but productivity has increased; the same situation has occurred in labor as the non-farm economy has expanded at a rate sufficient to absorb the growth in population.[15] In recent years this process has been aided by a significant decline in the birthrate, which has contained the rate of growth in population to relatively low levels. The subsistence sector in Japanese agriculture has shrunk to insignificant levels. Even so, the emphasis in Japanese agricultural policy has continued to be on capital investment complementary to land and labor with extraordinarily significant results in the postwar period. Only fairly recently has labor saving capital investment in the private sector started to appear.

In concluding the examination of these three cases it should be pointed out that they do not necessarily succeed each other in sequence. Whether they do or not is dependent mainly on the rate of growth in the non-farm sector accompanied by rapid increases in labor productivity as compared with the rate of growth in population. Thus expansion of the non-farm sector at a very high rate in Stage I compared with the growth in population may well result in the skipping of Stage II. The agricultural sector could then absorb labor saving capital investment and, with unused natural resources, develop along the line of the United States with primary emphasis on mechanization.

When, however, the growth in rural population exceeds the rate of absorption of population into the non-farm sector and is likely to continue to do so, a high man-land ratio in agriculture may well precede the introduction of investment and technological change. In this case the elimination of labor may not be possible and the resulting pattern of development will more nearly approximate the Japanese than the U.S. model.

Some Special Cases

This completes the exposition on the "standard" cases. Instances, have arisen and may well arise, however, under certain conditions where "special" cases call for extraordinary measures which would not be generally applicable. Here liquid capital investment of a complementary or a substitute nature may be possible.

Such special cases arise where for some reason the subsistence sector failed to respond to external stimuli with an adequate increase in production. The first such instance may result where due to cultural complexes no reaction to economic stimuli occurred. Here a country with developmental ambitions would need to invest through the public sector in education and other value-changing activities. A second case arises where demand may be increasing too rapidly for appropriate reaction

[15] Bruce Johnston, *op. cit.*

from the subsistence sector. A classic case is rubber between 1900 and 1924, when the phenomenal rate of growth in demand, beyond the supply facilities available in Brazil, resulted in the establishment of the plantation system in Malaya, Ceylon and Sumatra. In Burma development of the rice industry in the delta area called for the immigration of large quantities of labor from Upper Burma, and required liquid capital investment for the establishment of what was essentially a peasant industry. The lack of technical knowledge may prove a factor under certain circumstances. This played a part in the early stages of the introduction of the rubber industry in the Far East. It occurred also in tea when Chinese output was insufficient to meet the growing world demand and India, Ceylon and Indonesia entered into production under the plantation system. Here an additional factor, the need for quality controls and integration of production and processing, played a role.[16]

Several situations call for the investment of labor saving equipment in underdeveloped countries with an adequate labor supply and a subsistence sector but where new commodities are introduced in areas of the country where there is no subsistence production and where internal migration is not encouraged. Thus rice and cotton production in Colombia, corn in Central America and wheat and cotton in Mexico are being undertaken under large-scale mechanized conditions in newly developed areas. Finally where land cannot be farmed traditionally for technical reasons, mechanization may be possible for crops which are normally imported and protected. Thus in parts of the Middle East where irrigation is not feasible and where dryland cultivation will not support subsistence agriculture, mechanized grain farming similar to that in the western part of the United States and Canada may prove economically feasible under conditions of minimum seasonal rainfall.

Summary

This analysis brings us to the following conclusions with respect to the capital investment in agriculture.

(1) In Stage I, with a large subsistence section in agriculture, restricted markets, unused resources and scarce capital supply, investment of surplus labor in capital creating projects is recommended. Liquid capital should be used to extend and deepen the infrastructure along with certain anticipatory investment in social overhead.

(2) In Stage II, with little slack in unused natural and labor resources, social overhead capital investments become exceedingly important. Education, training programs, research and extension efforts to advance the scientific phases of agriculture are essential to substitute for the land re-

[16] V. D. Wickizer, *op. cit.*, p. 63.

sources no longer available and to provide new opportunities to raise the level of agricultural productivity. Where locational or cultural characteristics provide institutional barriers and non-competing groups in agriculture, several stages of development may exist within a single country, with consequent implied differences for investment decisions in various areas.

(3) A developed agriculture in Stage III, in which wage rates are increasing, has the capacity for making capital investments approaching those which we contemplate in American agriculture. Capital as a substitute for labor, resource development, the infrastructure and social overhead investments all need to move along in rough correlation if the agricultural sector is to move ahead effectively.

(4) In certain special cases conditions arise which would indicate a deviation from these prescriptions.

DISCUSSION: THE ROLE OF AGRICULTURE IN THE WORLD ECONOMY

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Both of these papers endeavor to find generalizations concerning agriculture which have world application. Professor Hillman concludes that actual agricultural productivity is influenced more by social and cultural factors than by available resources and potentially usuable knowledge. Professors Perkins and Witt conclude that in a subsistence economy capital will contribute more when invested in infrastructure but that as agriculture becomes more commercial an increased amount of capital should go directly into the agricultural process itself. While both papers contain many useful insights, their ultimate generalizations are too general to be very helpful.

One of the difficulties is that the word "agriculture" is itself such a generalization that it creates difficulties. The raising of crops and animals varies widely according to climate and soil conditions, the particular product involved, and the relevant state of the art. In Cyprus, where I have spent the last three months, agriculture consists of greatly differing subdivisions such as citrus fruits, wheat and barley, olives and carobs, grapes, and fresh vegetables. Not only are the agricultural processes and the resource mixes different in each case, but these differences are reflected in the pattern of village life and the level and character of living.

When one talks about the role of agriculture, it can be interpreted as these papers do, as if one were speaking of a role in a drama and there-

fore describing a character part. But even in drama a part takes on meaning only when it is related to the whole. It seems to me of great importance for us to know more about the part which agriculture can and should play in a developing economy. Should it be specially supported, and how will its behavior affect and be affected by the other sectors in the economy?

The papers mention such sector interlocks as the problem of credit and debt, the importance of marketing, and the relationship of agriculture to nonagricultural activity. I would have been greatly interested, for example, if the examination of investment had touched on the question of how much of an underdeveloped country's limited capital resources should be devoted to agriculture. The Perkins-Witt paper states that "the growth in the non-farm sector is the key to the development of commercial agriculture, apart from the international market." This might suggest that at least under some circumstances the best way to develop agriculture would be to put special emphasis on encouraging growth in the nonfarm sector. This approach has been supported by others who argue that a demand for products must be created, employment for the unemployed in agriculture must be provided, and that increased domestic processing will contribute to agricultural development. On the other hand it can be argued that agriculture in occasional circumstances may finance industrial development, as did the silk industry in Japan.

If one also emphasizes cultural and social institutions as a determinant, then one leading question is what developments will have the greatest impact for institutional change and contribute most to a breakthrough. For example, how important is electric power on the farm in its effect on productivity and social attitude? In connection with this general problem, it is interesting that the recently published study by Professor Chenery in the *American Economic Review,* September, 1960, seems to find certain regular relationships between agriculture and other economic activities which are determined very largely by the level of per capita income. Thus, based on the records of 48 countries, it appears that primary products contribute 46 percent to gross national product when per capita income is \$100 and 15 percent if it is \$1000. While agriculture is expanding but declining in its percentage of contribution, all other broad national income categories appear to rise in relative importance with increased income, with manufacturing the most elastic. Is there then a more or less "normal" pattern which seems to survive the many other varying factors which are usually summoned to explain agricultural differences? With improved data and better methods of analysis, we may be able to learn much more about the role of agriculture in the individual economy.

The fact that the title of this session is "Role of Agriculture in the World Economy" should not be entirely disregarded, and the element of

the international market has been mentioned in both papers though without any special discussion. Just as agriculture has its interlocking relationships with other parts of each economy, certain agricultural products are involved in considerable degree in world markets. One of the great threats to international economic stability at the present and in the immediate future is that individual country agricultural programs may lead to serious imbalance when they are added together. We are all familiar with the world wheat picture. A recent analysis by the United Nations Economic Commission for Asia and the Far East pointed out that rice import requirements in 1966 for ten countries would presumably be lowered by 1,100,000 tons while estimated exports for five countries would rise 800,000 tons, creating another surplus problem. Another forecast with respect to citrus fruit suggests that production is expanding far more rapidly than the prospects for consumption. This will create a new type of problem, that of a surplus of a rather perishable agricultural commodity. Both wine and raisins are in increasingly plentiful supply.

These prospective developments remind me of the forecasting difficulties which individual countries had during the pre-Marshall Plan period. When the various countries were asked to present material on which the necessity for economic assistance could be based, they found great difficulty in forecasting because the situation in each European country depended to a considerable degree on developments in other European countries. One of the great contributions made by the Marshall Plan was that it permitted the development of country programs with some degree of international balance. It seems clear that the contribution of agriculture to the world economy may prove to be very disturbing if it is the result of a number of independent national programs creating surpluses, and even more so when those national programs involve interferences with the price mechanism. The result might be the necessity for another session of the Association dealing with the role of the world economy in national agriculture.

DISCUSSION: THE ROLE OF AGRICULTURE IN THE WORLD ECONOMY

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Professor Hillman has presented us with a good summary of many of the facets of the problem of increasing agricultural productivity in less advanced countries. His concern is to separate the determinants of potential agricultural productivity which he calls the "set of opportunities," from the conditions under which productivity is actually increased. He

holds the firm belief that a change from lower to higher values of the output-input ratio (which he defines as his measure of productivity) depends less upon the opportunities for a more effective use of existing resources than upon a set of rigidities in the social, cultural and institutional matrix of a society.

I strongly endorse Hillman's desire to know more of the mechanisms by which the gap between "what is" and "what might be" may be narrowed, and his paper has many excellent suggestions as to how this might be done. However, I differ with him on a very significant point. Where he discusses land reform, improved markets, better credit facilities, etc., I would substitute a thorough examination of the real nature of the "set of opportunities." Where he would believe that "the greatest obstacles to increased productivity lie in the area of cultural, institutional and community conditions," I would counter with the hypothesis that the greatest obstacle to increased productivity is the lack of improved technology which is economically worthy of adoption by a cultivatior whose skills are, as yet, inadequate to meet the many complex demands of modern agriculture. The facts are clear, I think, that technologies which will yield a long run return above costs and risks, in the main, are lacking, and that if and where they do exist it is only the lack of knowledge, or a short run problem of risks and/or costs which prevent farmers from using them.

Hillman's remarks suggest that if only the cultural values and institutional mechanisms were changed agricultural productivity would be provided a fertile field in which to develop. There is undoubtedly much truth in this suggestion. But a review of development history would allow the opposite proposition where institutional and cultural change follows rather than leads the earlier stages of development. It is of little use to try and create entrepreneurship within a culture if there is nothing to be an entrepreneur with, or about. Likewise it is foolish to assume that price stability will lead to improved productivity if the technological requirements of this improvement are not readily at hand. And from my acquaintance with several underdeveloped areas, the potential technologies—the "stuff" the extension service extends—are very meagre and in most cases do not involve significantly new profit functions.

I also think the record is clear that where profit opportunities exist, they are accepted, and in their acceptance carry the institutional changes with them. The increase in the use of fertilizer in India is a case in point. Here, in a relatively short time span, the cultivator has demanded and used a new and profitable input, with the result that markets have expanded to embrace those who would supply a new class of product—agricultural chemicals. It is true that the adjustment was not instantaneous, but, even by American standards, it was rapid.

Let me suggest that we, as economists, leave the cultural speculations to the anthropologists, at least for now, and turn to assessing the process of development with the same critical eye we use in looking at the production structure of our own culture. The risk discounts in the less developed areas may be higher, but I have little doubt that one can use, as a working hypothesis, an economizing farmer who will adopt that which generates real increases in his returns, and who will reject that which does not. In either case his actions can be understood within the frame of economic study.

The Perkins-Witt paper concentrates on capital allocation and, in a sense, picks up where Hillman left off by examining three stages of agricultural development and positing the increased use of liquid capital as a nation passes from stage I to stage III. Like all taxonomic models of complex phenomenon one can be critical of the boundaries drawn between the stages, but I think it is clear that the authors realize they are talking of a continuum and thus remain flexible and, therefore, unassailable on this point.

However, any taxonomy must be regarded with skepticism, and in this case I feel the skepticism is justified. The distinction between the stages of development which the authors draw serve, in my opinion, little useful purpose. Every developing country I can think of fits each of the stages outlined. Commercial agriculture exists alongside subsistence farming; there are simultaneous needs for roads (the infra-structure) and an expansion of the social overhead; there are pockets of high wages and high productivity along with underemployment and zero marginal returns to labor. The authors concede these regional differences and suggest that their existence may call for differing governmental policies. However, it is precisely because this is generally the case, that the three-stage classification the authors outline is only of academic interest, it can hardly be of practical significance as a guide for policy.

I would hold that instead of trying to classify societies or regions into stages (and I realize this runs counter to today's fashion) it would be better to try and assess rates of return to various agricultural and extra-agricultural investments. Stress on roads, dams, etc., at one period of development may yield high returns in the next period, but it is also likely that simultaneous investment in both the infra-structure and social overhead (education, research extension services) will give higher returns in both periods in both the short and long run. If this is the case, then the policy implications of Perkins' and Witt's paper must be carefully hedged and therefore the distinctions they chose to draw between their stages is lost.

CONTRIBUTIONS OF ECONOMETRICS TO FARM PRICE AND INCOME POLICY*

CHAIRMAN: KARL FOX, IOWA STATE UNIVERSITY

METHODS, ASSUMPTIONS AND RESULTS OF THE PRICE AND INCOME PROJECTIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

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PREPARATION of economic projections has been among the important activities of the USDA for several decades. These activities have included projections for agriculture related to long-run trends in economic growth, as well as projections of the probable results of the application of specific types of programs to specific commodities or commodity groups.

Our primary assignment here is to discuss the specific projections prepared by the Department and published in Senate Document No. 77, 86th Congress, 2nd Session, 1960. However, we intend to use our discussion of these projections to illustrate the general methods used by the Department in making projections.

This project was initiated by a letter from Senator Ellender, Chairman, Committee on Agriculture and Forestry, U.S. Senate, to Secretary of Agriculture Ezra Taft Benson in May 1959. The Senator's letter requested the cooperation of the technical staff of the Department in the preparation of an objective report on probable market supplies and prices for the major farm products, and the probable aggregate farm output and level of farm prices for the period 1960-65. The request specified two key assumptions. These were: (1) removal of all production controls except those on tobacco; and (2) maintenance of price supports at levels which would permit an orderly reduction of excessive stocks of storable farm products over a 7- to 10-year period.

The responsiblity for coordinating the preparation of material within the Department in response to the Senator's request was assigned to a work group consisting of representatives of Farm Economics Research Division, Agricultural Research Service; Price Division, Commodity Stabilization Service; Agricultural Economics Division, Agricultural Marketing Service; and Foreign Agricultural Service.

* Joint Session with the Econometric Society.

** The authors wish to express their appreciation to Kenneth L. Bachman, J. P. Cavin, and Frederick V. Waugh of the Agricultural Marketing Service for their valuable suggestions.

In addition to the major assumptions specified in the original request, a number of additional assumptions were necessary to provide a framework for the preparation of the required projections. Included were a general economic framework and assumptions regarding other agricultural programs such as the Conservation Reserve, P.L. 480, etc.

These assumptions, which we will call secondary assumptions, were specified by the work group. In brief, it was assumed that for the economy as a whole, upward trends in population, productivity, and real income per capita would continue and that retail prices and prices paid by farmers would not rise significantly above the levels prevailing at the time the project was undertaken. It was also taken as given that there would be no major change in the international situation.

The secondary assumptions pertaining to agriculture specified a 30 million acre Conservation Reserve, the continuation of P.L. 480 at around then current levels, and that programs such as Section 32, Special Milk, School Lunch, Sugar Act, Wool Act, and Marketing Agreements and Orders would continue in effect without significant change.

Acreage and Yield

Acreage

The total acreage of cropland and pasture available was assumed to remain at the 1959 level during the 1960-65 period. The elimination of allotments on wheat and cotton, together with the increased Soil Bank was projected in the first year to result in reduced fallow and idle acreages. Consequently, the total land used for crops and pasture would increase. After this first year, however, it was assumed that the lower price level would encourage reductions in harvested cropland. While the acreage adjustments to this lower price level would not be completed by 1965, a decrease in harvested cropland of about one million acres a year was projected.

Projections of individual crop acreages were made by means of a series of successive approximations. Factors considered included suspension of allotments on wheat and cotton and expansion of the Conservation Reserve, prospective price-cost relationships, the livestock-feed balance, and recent trends. The evaluation of these factors necessarily involved large elements of judgement.

Yields

Yield projections for the period 1960-65, developed in cooperation with ARS natural scientists, were used as a general framework for the yield estimates of major crops. They included the increases that agricultural research scientists expected to result from futher applications of known improvements. The original projections were made in the general context

of current acreage and price-cost relations. It was assumed, however, that in a period of only five years, effects of less favorable cost-price relationships on yields would be minor because of the continued profitability from the standpoint of the individual farmer of further increases in the use of fertilizer, improved varieties, and other yield-increasing techniques.

Upward trends in yield per acre of feed grains were projected to continue in the years 1960-65. The annual rates of increase, however, would be less than in the years since 1940. Due to favorable weather, the yields of corn and grain sorghum in 1958, 1959, and 1960 were significantly above the indicated trend. Wheat and cotton yields were projected to increase gradually at about the same rate as their long-time upward trends. All these yield projections assume average or normal weather.

Exports

The export projections took into account the effects of the assumed elimination of acreage controls and reduction of price support. Many other factors not fully taken into account in these projections will influence the amounts of U.S. agricultural commodities foreign countries may be able or willing to import. It is possible that these factors might lead to substantially different levels of exports of specific commodities. In this area, the projections were very heavily weighted by the judgement of commodity analysts familiar with trends and conditions in foreign markets.

The world wheat trade is subject to extensive regulation, with most wheat importing countries maintaining some form of incentives to stimulate increased domestic production. The objectives of such programs have been to increase self-sufficiency in foodstuffs, to reduce foreign exchange expenditures, and to increase farmers' incomes. In view of these conditions, it may well be that even a marked reduction in wheat prices would expand U.S. wheat exports by only a limited amount.

For commodities not produced so extensively in importing countries, a reduction in prices could result in an expansion of exports. Prices along the line of those projected for cotton, for example, would enable cotton to compete successfully with synthetic fibers in manufacture of textiles in foreign countries. They would encourage consumption by low income groups and would probably stimulate world trade in cotton textiles. Furthermore, such prices for cotton would tend to discourage production of cotton in a number of foreign countries.

World trade in feed grains has expanded rapidly in the postwar period and the United States has increased its share of the total trade. With the scarcity of meats from the traditional exporting countries and the likelihood it will increase as their population expands, European countries are being pinched for an adequate supply of meats to meet their

increasing consumer demand. With lower feed grain prices, the United States could probably appreciably expand its sales of feed grains to the European countries which are the major importers.

Methods

We turn now to a brief general discussion of our methods. The commodity analysts were asked to make the projections in their commodity fields within the general framework discussed above.

In doing this, the information available in the Department on statistical relationships between supply, prices, and consumption and on long-time trends was used. However, many highly complex relationships are involved and knowledge concerning them is by no means perfect. Consequently, the use of a substantial amount of judgement was required.

The projections made by the commodity specialists were subjected to general checks for consistency. For example, it was necessary to make some adjustments in the projected planted acreages for individual crops in order to stay within the assumed total acreage framework. The first series of livestock projections added up to more grain-consuming animal units than could be fed from the projected feed supplies. As a result, a second series of livestock projections was required using adjusted feed prices to bring numbers of grain-consuming animal units into balance with feed supplies.

After the adjustments were made in the projections for the major commodities, general summary measures, including the indexes of farm output, prices received by farmers, and per capita food consumption were calculated and projections of total cash receipts from farm marketings were made. Not only are these summary measures useful in understanding the overall implications of the projections, but in addition, they make it possible to check the aggregate results of the individual commodity projections against what we know about general relationships between per capita food consumption, income, and prices received.

Under the assumed conditions, total farm output was projected to increase to 137 percent of the 1947-49 average for 1965. Compared to the 1955-57 average, the projected increases were 20 percent in total farm output, 25 percent in livestock, and 16 percent in crops.

The projected index of prices received was 193 for 1965, 17 percent below the 1955-57 average, with the index for crops down a little more and that for livestock a little less than the total.

Projected cash receipts from farm marketings at $30.6 billion would be 2 percent higher than in 1955-57, with cash receipts from livestock and products 7 percent higher and those from crops 4 percent lower.

For results by commodities and commodity groups, we refer you to the text and tables in Senate Document No. 77.

Research in Relation to Projections

Research directed at continually improving analytical tools for estimating and projecting trends in production, prices, and consumption has been a function of the Agricultural Economics Division for many years. This research has always depended on some combination of economics, mathematics, and statistics. Econometric research, as we now know it, is a continuation of the same idea but with more emphasis on refinements in economic theory and the use of the latest techniques in mathematics and statistics, including recent advances in computational facilities. As this shift in emphasis is relatively recent, it is not surprising that the use of econometric results in program appraisal is still in the early development stage.

The extent to which we have specific statistical analyses for any commodity or sector reflects the progress we have been able to make in that sector. We have published a series of technical bulletins on demand, supply, and price structure for commodities or groups of commodities designed to provide detailed information for some sectors. We still need information for other sectors. In most instances, research results published in our bulletins cannot be used directly, but often must be adapted to meet the requirements of the particular program analysis under consideration. Some might argue that more emphasis on the aggregate analyses should have preceded the details for each commodity. However, specific agricultural programs which have been enacted or proposed usually are on a commodity basis and, in the final analysis, the price and income received by farmers for specific commodities are not unimportant. In addition, evaluation of particular programs, including overall programs for all commodities, often requires more detailed knowledge than provided by the usual 10- to 20-equation aggregate analysis.

Where do we stand now? We have some fairly good clues as to the demand for individual commodities. From information obtained in statistical analyses, we can give reasonably good estimates as to the effect on price of a given percentage change in the supply of commodities such as milk, beef, pork, and eggs. We have obtained relationships for the demand for feed grains and byproduct feeds. We also have measures for the domestic demand for wheat and cotton. These relationships reflect normal year-to-year changes as obtained from statistical analyses of historical time series. In the past, our emphasis has been on the demand and price structures, but increasing research resources are now being given to measurement of supply, with emphasis on the feed-livestock complex. Our commodity analysts sometimes use these statistical relations directly in making projections. In most instances, some modification of the statistical relation is needed.

Do We Have a Single Statistical Measure?

Frequently, people would like to have a single and unique method which will systematically provide answers to all their problems, and so would we. But there may be several formulations, and each may have a special use, yet suffer serious limitations in other uses.

Do we have a single statistical formulation? A good statistical measure for program appraisal needs a matrix of coefficients which specifies the important interrelationships among all the relevant commodities under consideration. Information on cross elasticities from statistical analyses is available for some of the more important commodities, but most of it relates to measurement of observed changes in relative shifts between two competing commodities. For example, the competition between butter and margarine and between beef and pork has been measured. But we have not fitted a single statistical model which gives statistically significant coefficients for all the important cross elasticities.

Although we do not have a single measure, we do have a mass of knowledge—data, statistical analyses, and judgement—which can be brought into focus on the appraisal of the program under consideration. In fact, the final working model may be a synthesis of statistical information from several sources, including the judgement of experienced analysts. Such a procedure permits us to bring to bear on the problem information which formal fitted statistical relationships do not provide.

In assembling the results of several statistical analyses, we do have some check points which permit us to test our synthetic aggregation. These include aggregate analyses of some of the larger sectors and of agriculture as a whole. For example, the sum of the consumption estimates from individual demand relations which measure competition between individual commodities must be consistent with the consumption estimate from the aggregate statistical analysis for all food. And historically, there has been a considerable amount of stability in these aggregate measures; depressions, wars, and recessions apparently do not materially affect our food intake.

What are the advantages to synthesizing a complete model? An important consideration is that it provides answers that are internally consistent. A less obvious advantage is that it forces the analyst to specify all the relevant variables. Such a detailed examination frequently uncovers relevant information which otherwise might have been omitted. But do we know that using a system of equations which incorporates results from several analyses will give better estimates than those obtained directly from fitted regressions? There is no question that for the period of fit, estimates from the fitted system probably are better. But if the findings from a particular appraisal rely heavily on known "poor" coefficients, the

appraisal may produce doubtful results. Furthermore, knowing the structural cofficients for the past is not enough. These cofficients reflect observed changes in the historical past, while the magnitude of the changes proposed under program appraisal are often beyond the range of the normal changes observed in historical data.

General Comments, Limitations, and Evaluation

One point that needs to be emphasized is that we are talking about projections within a specific set of assumptions, not forecasts. The two key assumptions—no acreage controls and price supports at levels which would permit liquidation of excessive stocks over a 7- to 10-year period—were specified in the original request for the projections.

In our opinion, a series of projections for agriculture as a whole is inherently more difficult than projections for a single commodity or a group of related commodities. In making the latter type of projections, one can proceed on the assumption that other segments of the agricultural economy are held constant. In projections for the entire agricultural economy, this simplifying assumption is precluded. All the interrelations among the various crops, as well as those among the feed crops and all the livestock items, must be considered. Obviously, this not only makes the analysis far more complex but also multiplies the possibility of error for individual commodity projections.

Despite these difficulties, it is our belief that these projections provide consistent information on the general trends and relationships which might be expected to prevail under the assumed conditions. Within the framework of the key assumptions, farm output and per capita consumption would undoubtedly increase, and prices received by farmers would undoubtedly decline. However, the magnitude of the changes, particularly those for individual commodities, may well be subject to rather sizeable errors and hence, to considerable difference of opinion.

One specific example of a key point in the feed-livestock projections is the amount of feed concentrates consumed per grain consuming animal unit. For the feeding years 1950 through 1956, the amount of concentrates fed per animal unit ranged from a low of 0.77 ton in 1952 to a high of 0.81 ton in 1956. The average for the period was 0.79 ton. Subsequently, this rate increased very rapidly to 0.86 ton in 1957, 0.90 ton in 1958, and an estimated 0.96 ton in the 1959 feeding year.

A feeding rate of 0.84 ton was assumed in making these projections. With the number of grain-consuming animal units projected to be nearly 200 million by 1965, each 0.01 ton difference in the feeding rate would be equivalent to a difference of 2 million tons in the projected amount of feed grain fed to livestock each year.

The important point is that there was no uniquely determined rate of

feeding that could be used in projections of this type. The variations in the feeding rate in the past several years would provide justification for a somewhat different rate from the one that was used. The use of a different rate would, of course, have influenced the entire feed-livestock segment of agriculture.

The crop yield projections could be cited as another example of possible source of error. These yield projections based on increases that could be expected to result from further application of known improvements are regarded by some as extremely conservative.

The problem here is that the effects of weather and technology on crop yields are intertwined. The relative importance attributed to each of these as a determining factor in yields for recent years will have a major influence on the level of yield projections. An assumption that yields in the last few years have been above what could have been expected with average weather leads to a lower level of projected yields than an assumption that the adoption of new technology has been the primary influence on recent yield levels.

Average yields of several crops in 1958-60 equaled or exceeded the yields projected as attainable in 1965. Favorable growing conditions contributed to high crop yields in this period. However, there is also evidence that farmers are adopting known improvements at a more rapid rate than was projected.

If corn yields were projected to 1965 in line with the 1940-59 trend, the figure for 1965 would be 55 bushels per acre rather than the 51 bushels that was used.

Grain sorghum yields in 1965 might be projected to remain at about the 1958-60 level. This would assume that further increases in the use of hybrid seed would compensate for the effects of favorable weather on yields of sorghum grain in 1958-60.

The application of these higher yield projections to our projected acreage figures would add around 10 million tons, or 7 percent, to the 1965 feed grain projection.

These are among the reasons why we think, even as projections under specific assumptions, the data in Senate Document No. 77 must be regarded as rough approximations.

The process of formulating projections of probable output and prices of agricultural products that we have discussed perhaps should not be described as a method, if by method is understood a definite number of steps, taken in unvarying sequence and employing a fixed set of statistical relationships.

It does, however, have several attributes that we regard as important strong points. These are: (1) A vast reservoir of data; (2) A large number of statistical analyses of varying quality and complexity; (3) The abil-

ity to integrate results through the general summary measures; and (4) A large number of trained and experienced analysts concerned with practically every field within the economics of agriculture.

Our process means that analysts are required to test their specific analyses and judgement in relation to analyses and judgment of analysts whose primary responsibilities are in different functional fields. Thus, the acreage projections were a product of the combined analyses and judgement of ARS and AMS commodity specialists. Similarly, the export projections had the benefit of contributions from specialists from both FAS and AMS.

The fact that the materials are brought together and focused through a committee system often means that some compromises are necessary. In general, this means that our projections tend to be on the conservative side. (We are using conservative to mean near the middle of the range.)

We would point out that these rough approximations of probable agricultural output and prices under the assumed conditions are different from ideas held by a number of people who are seriously interested in discussions of farm policy.

During the past year or so, three other studies of production and prices of major farm commodities under assumed conditions approximating free production and marketing have been published. One of these will be discussed by its authors on this program. Each of these studies used somewhat different assumptions and, as might be expected, there are variations in the results. Time does not permit a detailed comparison of either the assumptions or the results. All four studies point to the same general conclusions. To us, this is more significant than the variations that do exist.

We certainly hope that the results of research, that in the colleges as well as our own, will provide the basis for technological breakthrough in methods used in making projections. Not only would this be important for its own sake, but it would also provide improved methods for our "bread and butter" field, Outlook and Situation work.

METHODS, ASSUMPTIONS AND RESULTS OF FREE MARKET PROJECTIONS FOR THE LIVESTOCK AND FEED ECONOMY

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IN THE spring of 1959 a group of leading midwest farmers requested the Center for Agricultural and Economic Adjustment at Iowa State University to make a study of "what would have happened in the past and what would happen in the future in the feed-livestock economy if there were no support-control programs." In response to this request, three studies[1] of the livestock and feed economy were made in 1959. The purpose of the one study discussed here was to indicate the consequences of pursuing a farm policy which would permit the full volume of future grain production to clear markets in the year produced. It was hoped that the projections might provide a base from which to measure the effects of alternative control or market removal programs on the feed livestock sector.

The study projected the values of more than 14 variables for some or all of 18 crops or classes of livestock for each of the years 1960 to 1963. In all, about 320 projected values were prepared. In general, the variables projected were the measures developed by USDA and published in the commodity situation reports.

The projection of prices and quantities for the feed livestock economy would have been impossible without the research contribution of numerous econometricians and agricultural economists.[2] During the past two decades, the stock of knowledge of structural relationships in agriculture has increased greatly. Nevertheless, many serious gaps remain, especially on the supply side. As a result, it was necessary to make judgments about several relationships. These were based on the best information at hand. Nevertheless, the projections are at best only rough approximations to the "true" values of the variables under the conditions specified.

[1] The three studies were: (1) estimated effects of no grain stock accumulation from 1952 to 1958; (2) projections for the feed-livestock economy for the 1960 to 1962 period with continuation of 1959 programs; and (3) projections for the feed-livestock economy from 1960 to 1963 with no supports and no controls. The three studies are contained in *Special Report* 27 of the Agricultural and Home Economics Experiment Station, Iowa State University, Ames, Iowa. Only the third study is referred to in this article.

[2] Among the many people whose work is reflected in this study, some deserve particular mention because of the direct nature of their contribution. This group includes: K. A. Fox, H. F. Breimyer, Wilbur Maki, R. E. Post, E. Learn, A. S. Rojko, G. G. Judge, G. T. Barton, G. S. Shepherd, F. Kutish, R. F. Daly, M. J. Gerra, and J. A. Schnittker.

Assumptions

Specific assumptions were made about government policies, the general economy, population growth, and the nature of the internal linkages of the feed-livestock economy. The projections depend on the particular choice of assumptions; other assumptions would produce other results.

To estimate the consequences of market clearing policies, it was necessary to specify or assume how and when the present policies would be changed. The following assumed policy changes seemed to articulate the study request and be administratively feasible:

1. The price support provisions for feed grain would end with the 1959 crop. Cotton acreage allotments and price supports also would end with the 1959 crop. Dairy price supports would end in January, 1960. Since the fall wheat crop already was planted, acreage allotments and price supports for wheat would continue for the 1960 crop and then be discontinued. Tobacco allotments and price supports would continue.

2. The present stock of feed grains, wheat and cotton would not be reduced during the period. They might be rotated, but would not be increased or decreased in total. All demands, domestic and foreign, would be met from current production.

3. Programs involving specific rates of export subsidy on wheat, cotton and feed grains would be eliminated. Sales for foreign currency or barter would be continued, but all shipments would come from current production.

4. The conservation reserve would continue through the 1960 crop with an additional 5 million acres added in 1960 to bring the total to 28 million acres. No new contracts would be signed for the 1961 or later years. Old contracts would not be renewed as they expired.

Since the consequences of a change to a market clearing policy would be influenced by conditions external to agriculture, it was necessary to specify or assume certain characteristics about the general economy. It was judged with the aid of experts that the most reasonable assumptions to make about the general economy were (1) continued growth in population at a rate of about 2.8 million per year, (2) continued good times, with per capita income growing steadily to $2050 by 1963, (3) a stable general price level and (4) a continued release of new technology in the economic system.

Internally, the feed-livestock economy was assumed to be linked together and influenced by the movement to market clearing conditions approximately as follows:

1. The volume of grain output would be influenced by the amount of land, labor and capital committed to the various crops and the productivity of these resources.

2. Under market clearing conditions, grain prices would adjust to a level which would induce full utilization of average weather production each year.

3. Various components of demand, including livestock, would absorb grain according to historical utilization patterns, adjusted for changing economic incentives and technical possibilities for expansion.

4. Increased grain consumption, accompanied by greater use of other inputs, would expand livestock production, slaughter and per capita supplies.

5. Livestock prices would adjust to a level which would induce consumption of these supplies.

6. The prices of individual livestock and livestock products would be influenced by the per capita supply of the product, per capita supplies of competing products and the level of disposable income.

7. Over time, the pattern of grain and livestock prices would influence the allocation of land among crops and the distribution of labor and capital, including feed, among livestock enterprises.

8. Ultimately, the level of farm prices would influence the total input of land, labor and capital and the average level of technology in farm production.

Method

In making the projections, we wanted to trace out a time path for each of the variables over the three-year period. The time path was conceived as a series of three short-run equilibrium situations. The values taken by variables in one period would be allowed to influence the levels of the next period. Different rates of expansion were used for each livestock product. The cyclical patterns of livestock variables were preserved in the projections. In taking account of the hog and cattle cycles, historical series were divided into trend and cycle components. Most of the adjustment was made in the trend component.

Projections of the values of all variables for the first year were made by modifications in the outlook information already available. Trends, forces and movements already underway were expected to continue with some modifications with the advent of market clearing conditions. Projections for the first year were completed before those for the second year were attempted. Then the projected situation in the second year was used in pushing ahead to the third year.

Total land under cultivation was projected to be the same each year as the 1959 total with correction for changes in the size of the conservation reserve. A judgment was made that reducing farm product prices would not immediately reduce the volume of land used in agricultural production. After the third year, it was decided, total land under cultivation might change, but because of lack of knowledge as to how it would change, the projections were not pushed beyond three years.

Yields were projected to continue to increase according to the trend of yields per planted acre from 1940 to 1958. It was a judgment that the labor and capital inputs per acre and the productivity of these resources would not be reduced enough to push yields below trends. There was

question whether sufficient labor and capital of high enough productivity would be used per acre after the third year to bring expected yields to the trend line. On the other hand, average yields in 1963 might be increased by planting only the best acres. Because of lack of information as to how much yield trends would be influenced by these opposing developments, crop projections were not extended beyond 1962.

The projected distribution of land among crops was influenced by trends, relative prices, growth in technology, and removal of acreage restrictions. For example, expansion of cotton was estimated by regions with the help of experts acquainted with cotton production locally. Some land was removed from feed-grain production as cotton expanded. The trend to continuous corn removed land from hay and added it to corn in the heart of the Corn Belt. The downward trend in oats acreage also shifted the mix of grain crops toward corn. In wheat, the acreages would be influenced by the removal of allotments and also by the reduction of wheat prices in relation to feed-grain prices. Inasmuch as the influence of various and sometimes opposing determinants of wheat acreage have not been accurately measured, the projected net effect was based on judgment.

The first approximation of grain utilization was based on the preceding year's pattern. The second approximation was determined by adjusting each individual component according to approximations of the elasticities of demand. In the case of a livestock class, the adjustment was related to the within-year production elasticity with respect to feed-grain prices.

Retail prices of livestock products were projected to indicate some of the impact of market clearing conditions on consumers. Farm prices were converted to the farm value of a pound of consumption at retail. To the farm value was added the average farm to retail spread of the last 10 years, corrected for trend. The resulting consumer prices were multiplied by projected consumption per average household to obtain the year by year budget of a household for livestock products.

Results

The completed results of this study have been published elsewhere.[3] In tables 1 through 4, projections for corn, wheat, hogs and cattle selected from the study are presented.

Evaluation

The approach chosen for the study had to be one workable in the time available to complete it. Its sophistication was influenced by the quantity and quality of information available. We needed a flexible model to provide an opportunity to account for new information not reflected in earlier parts of time series data. The preservation of the

[3] *Op. cit.*

TABLE 1. VALUES OF SELECTED VARIABLES FOR FEED GRAIN, 1957–59 ACTUAL AND 1960–62 PROJECTED WITH MARKET CLEARING CONDITIONS

Crop Year	Planted Acreage	Yield	Production	Utilization: Fed to Livestock	Utilization: Seed, food, Industry	Utilization: Exports	Price of Corn
	Million acres	*Tons per acre*	*Million tons*	*Million tons*			*Dollars per bushel*
1957	153.0	.93	142.3	113.9	12.4	10.5	1.12
1958	146.1	1.08	157.7	126.7	12.7	12.8	1.13
1959	154.7	1.08	167.1	126.5	12.6	13.0	1.06
1960	149.0	1.02	151.5	130.2	12.6	13.1	.79
1961	143.8	1.05	151.8	133.7	12.7	13.3	.77
1962	145.5	1.07	155.8	139.2	12.7	14.3	.66

TABLE 2. VALUES OF SELECTED VARIABLES FOR WHEAT, 1957–59 ACTUAL AND 1960–62 PROJECTED WITH MARKET CLEARING CONDITIONS

Crop Year	Planted Acreage	Yield	Production	Utilization: Domestic Food	Utilization: Seed and Industry	Utilization: Feed	Price
	Million acres	*Bushels per acre*	*Million bushels*	*Million bushels*			*Dollars per bushel*
1957	49.9	19.1	947	483.7	63.2	39.3	1.93
1958	56.4	25.9	1,463	495.5	65.6	73.1	1.72
1959	58.8	19.0	1,117	500.0	66.0	60.0	1.71
1960	58.3	21.0	1,224	500.0	73.0	60.0	1.67
1961	65.0	21.0	1,365	508.0	73.0	272.0	.90
1962	65.1	21.0	1,365	508.0	73.0	301.0	.74

TABLE 3. VALUES OF SELECTED VARIABLES FOR HOGS AND PORK, 1957–59 ACTUAL AND 1960–62 PROJECTED WITH MARKET CLEARING CONDITIONS

Feeding Year	Numbers Farrowed	Grain Used	On-Farm Production	Weight Slaughtered	Per Capita Consumption	Farm Price	Value of Output	Retail Price
	Million head	*Million tons*	*Billion pounds*		*Pounds*	*Dollars per 100 pounds*	*Billions dollars*	*Cents per pound*
1957	94.8	43.0	19.0	16.6	60.7	19.00	3.15	62.0
1958	103.2	48.8	20.5	18.5	68.3	15.70	2.90	57.4
1959	102.3	50.4	21.6	20.1	69.6	13.50	2.72	53.5
1960	98.6	50.5	31.2	19.4	66.2	14.20	2.76	55.5
1961	108.0	51.8	21.8	20.1	67.6	12.80	2.58	53.3
1962	110.0	53.0	22.5	21.0	68.8	11.00	2.31	50.0

TABLE 4. VALUES OF SELECTED VARIABLES FOR CATTLE AND BEEF, 1957–59 ACUTAL AND 1960–62 PROJECTED WITH MARKET CLEARING CONDITIONS

Feeding Year	Cattle on Hand	Cattle on Feed	Grain to Grain-Fed	On-Farm Production	Weight Slaughtered	Per Capita Consumption	Farm Price	Value of Output	Retail Price
	Million head		*Million tons*	*Billion pounds*		*Pounds*	*Dollars per 100 pounds*	*Billion dollars*	*Cents per pound*
1957	93.4	5.9	9.7	27.7	25.8	87.2	21.90	5.6	73.9
1958	96.9	6.5	11.4	29.7	24.7	87.3	23.00	5.7	76.4
1959	102.0	6.9	11.7	32.2	25.9	89.0	22.00	5.7	75.0
1960	106.0	7.3	12.2	34.4	27.3	91.1	20.90	5.7	73.4
1961	110.0	7.4	12.5	35.9	32.5	99.2	15.50	5.0	62.6
1962	113.0	7.7	13.8	37.2	35.4	105.2	12.00	4.3	55.8

cyclical elements of livestock variables, and the sequential analysis made it possible to estimate variables during a transition or disequilibrium period.

The simplicity and flexibility of the approach also presented a difficulty. Unlike a general mathematical model of the farm industry, the approach does not simultaneously consider, systematically and logically, all relevant variables. It has no automatic mechanism for generating consistent estimates. Consistency was improved by a process of inspection and successive readjustment of prices and quantities—not a very rigorous procedure at best.

The projections covered a period of three years. This is not sufficient time to allow for adjustment in product mix, resource use and farm reorganization. Studies of this kind would present the consequences of alternative policies more completely if they could project the time path of prices and quantities over periods greater than five years.

Within the three-year period, additional information on production response would have enhanced our confidence in the projections. There was no purely objective basis for measuring program effects on the land use pattern. There is no model at present that accurately accounts for the variation in crop yields over time. We had to use the common practice and rely on past trends. This is an unsophisticated procedure. Much hinges on the choice of trend period. We used the 1940-58 period, but almost equally good reasons could be offered for selecting a more recent period. The evidence favoring one over the other was neither clear nor definite. Yet the more recent period gives significantly higher quantitative levels of projected crop production.

There was also a lack of quantitative information on the effects of price support and control programs on production via price uncertainty. It was recognized that elimination of the programs would increase price uncertainty and tend to reduce farm output and shift the product mix

away from supported commodities. However, there was no basis for quantifying these effects in the projections.[4]

The effects of lower prices of feed grains on the combination of livestock and the pattern of livestock production are largely a matter of judgment. The recent figures on feed conversion rates exhibit considerable variation that cannot be easily explained, thus throwing some doubt on their reliability. The production elasticities of livestock classes with respect to feed-grain prices vary with the length of the adjustment period. This is also true for the production elasticities with respect to product prices. In both cases, the elasticities likewise vary among livestock classes for a given time period. Estimates of the production elasticities and cross elasticities were not available. While an effort was made to allow for the differences, one cannot be confident about the results. There was no way of knowing whether the projected expansions in alternative livestock enterprises represented situations of equal profitability and therefore a temporary equilibrium.

In taking account of the hog and cattle cycles, a new short-run trend was projected with a different slope and Y-intercept. The "normal" cycles were continued around the new trend. While this seemed to be a reasonable view, it rests on a rather tenuous empirical footing.

Available estimates of the demand elasticities varied widely. This created a difficult problem of deciding which estimates to use. The decision was made on the basis of a judgment of the technical defensibility of the methodology and data employed. Even so, the "own and cross" elasticities for individual livestock products were not consistent with other estimates of the elasticity of total livestock product demands. In a few cases only one elasticity estimate was available for a commodity and this had a large standard error.

Improving Information on Production Response

Perhaps the most critical limit to confidence in projections for the farm economy is the unsatisfactory state of our knowledge of production response. After many years of near neglect, this area recently has been receiving increased research attention. More is needed.

The problem has been approached along two distinct lines. One represents a logical extension of the approach incorporated in some of the 1930 studies of production response. The recent studies reflect a marked improvement in basic research methodology in economics. These efforts involve the development of more and more complex macro-economic

[4] See for example, Johnson, D. Gale, *Forward Price for Agriculture,* Univ. of Chicago Press, 1947; and Kaldor, Donald R., and Heady, Earl O., *An Exploratory Study of Expectations, Uncertainty and Farm Plans in Southern Iowa Agriculture,* Res. Bul. 408, Agr. Expt. Sta., Iowa State Univ., 1954.

models based on time series data. The Cromarty model is perhaps the most extensive application of this approach.[5]

The other approach focuses on the behavior of the firm. It uses linear programming or budget analysis to develop supply relationships for individual farms.[6] By summing the responses for a representative sample of farms, aggregate supply relationships may be developed for products and areas. This approach is currently being used by the Farm Economics Research Division of the USDA.

Both of these approaches have practical limitations that cannot be gone into here. Nevertheless, efforts along both lines should certainly be encouraged, inasumch as supply response information is badly needed and there is little evidence to suggest that one approach is superior to the other.

However, there is a third possible approach which might be worth further developing and testing. It would involve the use of producer panels much like the consumer panels that have been employed in preference and demand studies. Thus it would focus on the individual firm. But unlike the programming approach, it would not require detailed information on individual firm goals and transformation functions. If an individual farmer could predict his own actions in response to a specified change in the conditions of production, his answers would provide a basis for estimating production response. By use of a representative sample of farmers, aggregate production responses might be estimated. Analysts question whether farmers themselves can tell how much and when production would respond as the conditions of production are altered. However, it seems presumptuous to rely entirely on simulated models of expectation, decision making or historical behavior. A similar technique is used presently on a short-run basis by the Crop Reporting Service as it predicts crop planting, pig crops, and cattle marketings.

Conclusion

In spite of limitations, projections of the type reported on in this paper, can play a useful role in policy decisions. The alternative to basing policy choices on projected consequences is to base these decisions on still more limited knowledge.

The quality of projections can be improved by the development of better models and improved estimates of relationships. This will involve greater understanding and quantified estimates on the role of expectations and uncertainty on production response. Then projections can provide even more complete and accurate information on which to base policy decisions of the future.

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[5] William A. Cromarty, "An Econometric Model for United States Agriculture," *J. Amer. Stat. Assoc.*, Vol. 54, No. 287, pp. 556-74.

[6] See unpub. theses of Eddie Easley, Randolph Barker and Laurel Loftsgard, Iowa State Univ. Library.

FREE MARKET PRICE PROJECTIONS BASED ON A FORMAL ECONOMETRIC MODEL

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Connell & Company

WE ARE in the infancy stage of estimating the economic interrelationships among agricultural commodities. The slowness of development is in part a result of the three usual apologies given: lack of data, inadequate statistical techniques and complexity of making statistical estimates. However, after some 5 years of working with this problem, I have concluded that an additional major obstacle to achieving useful results in the lack of application of research results to particular policy problems and the failure to remold and re-estimate the econometric models until they begin to meet the needs of policy formulators. Since the company I am with is involved in making policy recommendations for firms dealing in agricultural commodities based upon statistical models, we have had to formulate, reformulate and live day to day with econometric models. They must be designed to answer specific problems, and if used as a basis to provide answers to other problems they may break down as useful tools.

The econometric model reported here was designed to answer the following policy questions:

1. What would be the effect upon production and prices of wheat, feed grains and livestock products if price supports were eliminated on wheat and feed grains?

2. What would be the effect, if in addition to the above, the government was to release sizeable quantities of commodities stored by the Commodity Credit Corporation (CCC) onto the domestic market in an attempt to reduce the current surplus?

Needless to say this research project does not supply final and adequate answers to these problems. It is felt, however, that it does qualify as a system of behavioral relationships which could be reformulated to provide satisfactory answers.

The interrelationships existing between wheat, feed grains, livestock and livestock products preclude the use of an approach which analyzes these commodities one by one. The ceteris paribus conditions simply do not hold, and as far as is possible the existing interrelationships should be built into the economic structure of the model. I say, "as far as possible" because it is impossible to satisfactorily describe in a statistical model all of the interrelationships which exist. One can cite lack of data as the resson for such an impossibility, but probably of equal importance is the lack of knowledge on the part of any one person to make such a description. In this latter respect we must be satisfied to consider the results of any

econometric model as the basing point for forecasting producer and consumer behavior and consult persons who have an intimate knowledge of specialized commodity areas for additional information in moving away from the basing point. Or, to state it more formally, we cannot incorporate all structural changes into the statistical model, but must rely upon subjective judgment to provide a basis for evaluating some structural changes. It is often difficult to quantify such subjective judgments and this, after all, may be our primary motive for carrying out the analyses.

As regards statistical estimating criteria or techniques, I do not want to become involved in any controversy as to which is most desirable. At Connell and Company we have used least squares, two-stage least squares, limited information and full information fitting procedures. Logical arguments can be presented for the particular selections made. This particular research project combines the use of least squares and limited information techniques in an attempt to get maximum likelihood estimates of the parameters. In general, the supply relations for crops and the CCC demand relationship for wheat are calculated by least squares, while the demand relations for crops and demand and supply relations for livestock products are estimated by using the limited information approach.

Econometric Models

Two statistical models are developed. One deals with the wheat economy and the other with the feed-livestock economy. While the two economies are not independent, there are some statistical reasons why they are treated as separtate models. Part of the interdependence is recognized by including feed grain prices in the wheat model and wheat prices in the feed grain model.

The individual products studied are wheat, feed grains (corn, barley, oats, sorghum grains), beef cattle, milk, hogs, eggs and poultry meat.[1]

For the wheat economy, four demand relations and one supply relation are considered. The demand relations cover the utilization of wheat (a) for food and industrial purposes, (b) as a livestock feed, (c) as a net acquisition to CCC stocks, and (d) to be carried over into the next crop year in private inventories. The crop year considered is July-June, and the observations used in estimating the relationships are the years 1929-1957 inclusive.

Three demand relations and one supply relation are investigated for feed grains. The demand relations cover the use of feed grains (a) for livestock feed and industrial use, (b) as net acquisitions to CCC stocks,

[1] A more complex model, involving additional commodities, was constructed in a previous study and is summarized in William A. Cromarty, "An Econometric Model for United States Agriculture," *J. Amer. Stat. Assoc.*, 54:556-74, Sept. 1959.

and (c) as private inventories carried forward into the next crop year. The unit of observation is the October-September crop year, and the observations cover 1929-1957 inclusive.

For livestock and livestock products a demand and supply equation is constructed for each of the five categories except poultry meats, where no adequate supply relationship could be obtained. The unit of observation in all cases in the January-December calendar year and the observations, as previously, include the years 1929-1957.

Wheat model

The estimated structural equations are summarized below with the standard errors of the coefficients in parentheses. Values of all variables labelled X_i must be known or estimated independently of the wheat system developed in this study. This is not a simple matter and may be responsible for errors in predicted values of the Y_{ij}.

I. *Production model for wheat*

Percentage acres seeded to wheat

(1.1) $$Y_{18} = 16.5 + \underset{(.03)}{.09}(Y_{12})_{-1}$$

Yield per seeded acre

(1.2) $$Y_{17} = 3.5 + \underset{(.02)}{.14}X_{10} + \underset{(.02)}{.07}X_9$$

II. *Demand model for wheat*

Supply-utilization identity

(1.4) $$A_5 = Y_{13} + Y_{14} + Y_{15} + Y_{16}$$

Commercial demand

(1.5) $$Y_{13} = 657.3 - \underset{(.77)}{2.04}(Y_{12}/Z_2) + \underset{(.05)}{.02}X_1 - \underset{(1.0)}{.003}X_2 + \underset{(.13)}{.18}X_7$$

Feed demand

(1.6) $$Y_{14} = 176.9 - \underset{(.72)}{2.08}(Y_{12}/Z_2) + \underset{(1.33)}{1.46}X_3 + \underset{(36.9)}{198.7}X_4$$

Private inventory demand

(1.7) $$Y_{15} = 877.6 - \underset{(1.02)}{4.02}(Y_{12}/Z_2) + \underset{(.06)}{.10}X_5' - \underset{(.19)}{.78}X_6$$

Net acquisitions by CCC

(1.8) $$Y_{16} = 12.1 - \underset{(2.1)}{5.2}X_3 - \underset{(7.4)}{80.8}X_4 + \underset{(.10)}{.45}X_5 + \underset{(.24)}{1.31}X_8$$

These equations are solved by algebra to obtain the reduced form

equations that provide estimates of each of the simultaneously determined variables in a particular year or situation.

Definitions of variables

Y_{11} = production of all wheat, in million bushels
Y_{12} = price of wheat, 1910–14 = 100
Y_{13} = commercial demand for wheat, in million bushels
Y_{14} = quantity of wheat consumed as livestock feed, in million bushels
Y_{15} = inventory carryover of wheat, exclusive of CCC, in million bushels
Y_{16} = net acquisitions of wheat by CCC, in million bushels
Y_{17} = yield per seeded acre of wheat, in bushels
Y_{18} = acres seeded to all wheat as a percentage of total acres seeded to wheat and feed grains
X_1 = per capita disposable income, in dollars
X_2 = the farm-retail price spread for cereal and bakery products, 1947–1949 = 100
X_3 = number of poultry units on farms January 1, 1947–49 = 100
X_4 = dummy variable, 1942–45 = 1, and 0 otherwise
X_5' = supply of wheat, exclusive of CCC stocks, but including CCC releases to domestic market, in million bushels
X_5 = supply of wheat, exclusive of CCC stocks, available for domestic use, in million bushels
X_6 = winter wheat planted, in hundred thousand acres
X_7 = commercial demand for wheat in the previous year, in million bushels
X_8 = national average support price for wheat, in cents per bushel
X_9 = index of weather conditions, 1943 = 100
X_{10} = square root of tons of fertilizer nutrients applied in the North Central States, in hundred thousand tons.
Z_2 = index of feed grain price, 1910–14 = 100

Supply, demand and price predictions based on the wheat model

Predictions from the model can be tested against the actual data of 1958 and 1959 and some estimates for 1960. The acreage equation estimated seeded acreages for 1958-59-60 at 57.4, 60.0 and 58.2 million acres respectively. These compare with actual seeded acreages of 56.4, 58.0 and 56.6 million acres. The fact that allotments were in effect probably accounts for the consistent overestimation of acreage.

The yield estimates for the same years were 20.1, 19.8 and 19.9 bushels per seeded acre. These compare with the actuals of 26.0, 19.4 and 24.1 bushels per acre. The model predicted that yields in 1958 would increase by 2.2 bushels per acre, but the actual increase was about 7 bushels. Consequently it underestimated production by about 300 million bushels in 1958. In 1959 it was within 60 million bushels of actual production and in 1960 again underestimated by 200 million bushels, mainly because it again failed to estimate the large increase in yields which took place.

The reasons for such errors are faulty construction and poor data. However, in all fairness to the model it should be recognized that the Stallings weather index was estimated by me for these years and errors are known to exist in my estimates for this index. It is a major job to keep it up to date, and one that currently has not been undertaken.

Based upon equations (1.4) – (1.8), the price and demands for wheat were estimated for the 1958-60 period. Table 1 summarizes the actual

and calculated values. While the government acquisitions were missed by 100 million bushels in 1958, it is significant that the model predicted an increase in deliveries to CCC from the 1957 level of 168 million, to the 1958 calculated value of 368. In 1959 the CCC deliveries were estimated quite accurately and in 1960 the model says they will increase by 100 million bushels or more over the 1959 figure.

The model consistently underestimates prices for the 1958-59 period. Perhaps in a reformulation a restriction should be included which prevents the farm price from falling below the loan rate by more than, say, 8 cents. In earlier years the farm price fell below the support rate by as much as 17 cents per bushel, but it may be that more farmers take more advantage of the loan program now and this lower limit is justified.

TABLE 1. DEMAND AND PRICE OF WHEAT, ACTUAL AND CALCULATED

Variable	Unit	1958		1959		1960
		Actual	Calculated	Actual	Calculated	Calculated
Commercial demand	Mil. bu.	547	570	546	543	561
Feed demand	Mil. bu.	54	70	49	42	54
Private inventory	Mil. bu.	148	198	118	113	145
CCC net acquisition	Mil. bu.	468	368	167	191	282
Price	$/bu.	1.75	1.53	1.76	1.64	1.53

The model also seemed to pick up quite well the variations in private inventory demand and the amount used as livestock feed.

Free market price projection for wheat

The stage is now set to estimate what would happen to the production, demands and price for wheat under several proposed alternatives.

Since the models are constructed using annual data, they should perform best in predicting one year in advance. As additional data become available at the end of a year they should be added to the model and revised structural equations and reduced forms computed. I am ignoring such desirable procedures and using the model to forecast events for the 1958-61 period. This 4-year period was chosen because the results may be compared with what actually happened for a part of the period and also because actual values for some of the predetermined variables are available for the 1958-59 period.

Three alternative policies are investigated, and the assumptions are stated and results summarized for each case.

Case I. Assumptions used for Case I were as follows:

1. Actual exports for 1958 and 1959 are used, while for 1960 and 1961 they are held at 550 million bushels.
2. All exports come from current production.

3. No loan or price support program is in effect.
4. No acreage allotments are in effect.
5. Combined feed grain and wheat acreage is held at the 1959 level of 217 million acres.
6. Feed grain prices are assumed equal to the actual values for 1958 and 1959, and for 1960 and 1961 are assumed equal to the 1959 values.
7. The weather index is held at the 1959 level.
8. CCC stocks are held at 1958 levels (no domestic or export releases).

The results from Case I are summarized in Table 2.[2] For 1958 the actual production of 1,462 million bushels is used. The price is estimated to

TABLE 2. DEMAND AND PRICE PROJECTIONS FOR WHEAT, CASE I

Variable	Unit	Year			
		1958	1959	1960	1961
Yield per acre	Bu.	—	19.8	19.9	20.1
Seeded acreage	Per cent	—	26.4	27.4	28.3
Production	Mil. bu.	1462	1135	1192	1240
Price	$/bu.	1.15	1.29	1.37	1.34
Commercial demand	Mil. bu.	630	604	597	600
Feed demand	Mil. bu.	125	98	80	87
Private inventory	Mil. bu.	305	229	198	206

fall from the actual 1957 level of $1.94 per bushel to $1.15. For the 1959-61 period, production is estimated, and because it is far below 1958, the farm price increases to $1.37 in 1960 and then drops to $1.34 in 1961. Commercial usage jumps to about 600 million bushels from the 1957 figure of about 540 and stabilizes in this area. Feed demand approximately doubles, and private inventories go from about 50 million bushels to 300 million bushels in 1958 and then level off at about 200 million bushels. Since corn prices are assumed to remain at about $1.03 per bushel, wheat is still not directly competitive as a livestock feed.

Case II. The second policy proposal differs from the first in that the government now subsidizes wheat as a livestock feed. The wheat fed is still to come out of current production. All other assumptions hold as given for Case I. The results of this proposal (see Table 3) are to increase wheat prices over those predicted in Case I, but they still fall short of current market levels based upon the support program. The feed demand for wheat is in the area of 250 million bushels, about three times as large as under Case I. Private inventory demand drops from 206 million bushels in 1958 to 116 million in 1961. Commercial demand does not vary greatly from the 1957 level. The assumptions in Case II require that such an abrupt change in the amount fed to livestock is possible, i.e., it

[2] Values of predetermined variables follow the discussion of all three cases. Variables are as previously defined.

TABLE 3. DEMAND AND PRICE PROJECTIONS FOR WHEAT, CASE II

Variable	Unit	Year			
		1958	1959	1960	1961
Yield per acre	Bu.	—	19.8	19.9	20.1
Seeded acreage	Per cent	—	29.2	30.0	30.7
Production	Mil. bu.	1462	1253	1295	1339
Price	$/bu.	1.48	1.58	1.66	1.63
Commercial demand	Mil. bu.	580	577	542	544
Feed demand	Mil. bu.	275	250	232	238
Private inventory	Mil. bu.	206	140	108	116

is a substitute for feed grains and not an additional demand for feed grains. A more gradual implementation could be made by restricting the quantities diverted as a livestock feed until animal units increase. The higher prices for wheat result in higher estimates of production than occurred in Case I. As production builds up it eventually reaches a point where prices begin to decline and production would then also begin to decline.

Case III. One of the real problems existing is the reduction of current CCC stocks. Case III assumes that the conditions imposed under Case I hold except that half of the exports come from current production and half are supplied from CCC stocks, which were assumed to be at the June 1, 1958, level. These changes in assumptions result in very different predictions (see Table 4). Wheat prices are some 35 cents a bushel lower, production of wheat drops off, even though yields are the same, and private inventory demand is much higher under Case III. The model says that commercial demand should increase by about 100 million bushels, which seems too high based upon what we know about the food demand for cereal products. Feed demand is about double that predicted for Case I, mainly because wheat prices are in a competitive price range with corn.

Table 5 indicates the values used for the predetermined variables. (More complete definitions are shown on page 368.) Other predetermined variables involving lagged quantities and prices of wheat are cal-

TABLE 4. DEMAND AND PRICE PROJECTIONS FOR WHEAT, CASE III

Variable	Unit	Year			
		1958	1959	1960	1961
Yield per acre	Bu	—	19.8	19.9	20.1
Seeded acreage	Per cent	—	26.5	24.7	25.1
Production	Mil. bu	1462	1139	1064	1093
Price	$/bu.	1.17	.96	1.00	.98
Commercial demand	Mil. bu.	621	663	664	668
Feed demand	Mil. bu.	122	151	140	144
Private inventory	Mil. bu.	318	386	371	375

TABLE 5. DATA FOR PREDETERMINED VARIABLES

Variable	Year			
	1958	1959	1960	1961
Per capita income	1818	1884	1920	1957
Farm-retail spread	149	153	155	157
Poultry units	85	88	84	86
Acres winter wheat	446	444	446	448
Price feed grains	159	150	150	150
Weather index	140	130	130	130
Wheat support price	0	0	0	0
Fertilizer applied	47.3	50.5	51.3	52.3

culated directly from the model and vary according to each particular set of assumptions used.

Feed Grain-Livestock Model

The feed grains considered are corn, oats, barley and sorghum grains. These are aggregated into one composite called "feed grains" simply by summing the quantities of each on a weight basis. The feed-grains model consists of four equations. The first of these is a production relation and the others represent commercial demand, private inventory demand, and net deliveries of feed grains to the CCC. A supply and price determining or demand relation was estimated for each of the beef cattle, milk, hogs, eggs and poultry meat categories except that no satisfactory supply relation could be constructed for poultry meat. Production of each of these categories is assumed equal to consumption, a simplifying assumption designed to eliminate inventory equations.

The structural equations, giving the coefficients and standard errors of the coefficients, follow along with the definitions of the variables.

Structural equations

(2.1) $$Y_{21} = 583.7 - \underset{(2.24)}{4.61}\,(Y_{12}/Y_{22})_{-1} + \underset{(.94)}{6.88}Z_{22} + \underset{(1.71)}{10.99}Z_{23}$$

(2.2) $$Z_{21} = Y_{23} + Y_{24} + Y_{25}$$

(2.3) $$Y_{23} = -28255 - \underset{(10.97)}{45.91}Y_{22} + \underset{(3.35)}{2.04}Y_{32} + \underset{(33.60)}{78.70}Y_{42} + \underset{(4.61)}{12.31}Y_{52} + \underset{(71.8)}{740.5}Z_{25}$$

(2.4) $$Y_{24} = 18144 - \underset{(1.95)}{6.91}Y_{52} + \underset{(.06)}{.23}Z_{21} - \underset{(71.74)}{283.61}Z_{25} + \underset{(29.38)}{128.28}Z_{26}$$

(2.5) $$Y_{25} = -1121 - \underset{(2.34)}{7.97}Y_{22} + \underset{(.04)}{.18}(Y_{21})_{-1} - \underset{(.06)}{.017}Z_{27}$$

(3.1) $$Y_{31} = 1103 + \underset{(.47)}{2.61}Y_{32} + \underset{(.02)}{.43}Z_{31} - \underset{(1.15)}{5.07}(Y_{22})_{-1}$$

(3.2) $$Y_{32} = 424 - \underset{(.035)}{.056}Y_{31} + \underset{(.17)}{.47}Y_{52} + \underset{(.50)}{1.35}Z_{32} - \underset{(.02)}{.05}Z_{34}$$

$$(4.1)\quad Y_{41} = -177532 + \underset{(218.70)}{308.74Y_{42}} - \underset{(89.10)}{122.02Y_{22}} + \underset{(6.06)}{10.71Z_{41}}$$

$$- \underset{(395.08)}{67.99Z_{42}} + \underset{(12.11)}{12.12Z_{43}}$$

$$(4.2)\quad Y_{42} = 1883 - \underset{(.004)}{.017Y_{41}} + \underset{(.18)}{.85Z_{32}} - \underset{(1.83)}{6.68Z_{33}} + \underset{(1.47)}{.50Z_{44}}$$

$$(5.1)\quad Y_{51} = -224 + \underset{(.08)}{.21Y_{52}} + \underset{(.002)}{.0015(Y_{21})_{-1}} + \underset{(.002)}{.0036Z_{21}} + \underset{(.03)}{.12Z_{51}}$$

$$(5.2)\quad Y_{52} = 9.54 - \underset{(.23)}{.53Y_{51}} + \underset{(.16)}{.011Y_{32}} + \underset{(13.17)}{68.67Y_{72}} + \underset{(.40)}{.58Z_{32}}$$

$$(6.1)\quad Y_{61} = -29 + \underset{(.74)}{1.71Y_{62}} + \underset{(.060)}{.036Z_{61}} + \underset{(.16)}{.51Z_{62}}$$

$$(6.2)\quad Y_{62} = 11.3 - \underset{(.16)}{.098Y_{61}} + \underset{(.02)}{.13Y_{42}} - \underset{(.06)}{.16Z_{33}}$$

$$(7.2)\quad Y_{72} = 17.6 + \underset{(.002)}{.00049Y_{32}} + \underset{(.003)}{.012Y_{52}} + \underset{(.012)}{.017Z_{32}} - \underset{(.0021)}{.0028Z_{71}} - \underset{(.08)}{.21Z_{33}}$$

Definitions of variables

Y_{12} = price of wheat, 1910–14 = 100
Y_{21} = production of feed grains, in thousand tons
Y_{22} = index of feed grain prices, 1947–49 = 1000
Y_{23} = commercial demand for feed grains, thousand tons
Y_{24} = net deliveries of feed grains to CCC, thousand tons
Y_{25} = private inventory demand for feed grains, thousand tons
Y_{31} = liveweight production of cattle and calves, million pounds
Y_{32} = price of beef, cents per cwt.
Y_{41} = production of milk, million pounds
Y_{42} = price of milk, cents per cwt.
Y_{51} = liveweight hog slaughter, tens of million pounds
Y_{52} = price of hogs, cents per cwt.
Y_{61} = production of eggs, millions
Y_{62} = price of eggs, cents per doz.
Y_{72} = price index for poultry meat, cents per pound
$(Y_{21})_{-1}$ = production of feed grains lagged 3 months, thousand tons
$(Y_{22})_{-1}$ = price of feed grains lagged one year, 1947–49 = 1000
Z_{21} = available supply of feed grains, thousand tons
Z_{22} = Stallings index of weather conditions
Z_{23} = fertilizer applied in North Central States, hundred thousand tons
Z_{25} = grain consuming animal units fed, Oct. year, in millions
Z_{26} = national average support price for corn (compliance), cents per bushel
Z_{27} = government stocks of feed grains on Oct. 1, thousand tons
Z_{31} = Jan. 1 inventory of beef cattle, thousand head
Z_{32} = per capita disposable income, dollars
Z_{33} = index of cost of marketing services, 1947–49 = 100
Z_{34} = cattle and calves on hand Jan. 1, (year t-4)–(year t-3), thousand head
Z_{41} = Jan. 1 inventory of dairy cows and heifers, thousand head
Z_{42} = Apr.–Nov. index of pasture conditions, as percent of normal
Z_{43} = number of Dairy Herd Improvement Associations
Z_{44} = ratio of milk manufactured to fluid use, percent
Z_{51} = Jan. 1 inventory of sows and gilts over 6 months, thousand head
Z_{61} = Jan. 1 inventory of hens and pullets, million
Z_{62} = number of birds in National Poultry Improvement Plan, million
Z_{71} = Sales of poultry meat, million pounds

Supply, demand and price predictions based on the feed-livestock model

The model is tested for the 1957-59 period against the actual values, and then used to predict resulting levels of production and prices given certain sets of assumptions. The time periods are calendar years for livestock categories and crop years beginning the previous October for feed grains, except for Y_{25}, where it is October of the year listed.

The production estimates for feed grains in the post-sample period consistently fall below the actual estimates (see Table 6). A part of the error, as in the case of wheat, is due to my estimates for the weather index rather than those consistent with the Stallings procedure. I also feel that the model would not in any case pick up the sharp yield increases which occurred. Average yields of the four feed grains increased from .87 tons

TABLE 6. ACTUAL AND CALCULATED VALUES FOR FEED-LIVESTOCK MODEL, 1957–59

Variable	Unit	1957		1958		1959	
		Actual	Calculated	Actual	Calculated	Actual	Calculated
Feed grain production	Mil. tons	142.9	135.1	157.6	155.9	165.7	151.6
Feed grain prices	1947–49 = 100	73.5	76.8	64.8	69.4	65.3	62.9
Commercial demand	Mil. tons	117.8	116.3	123.9	123.6	133.9	124.5
Net deliveries to CCC	Mil. tons	15.9	14.0	19.2	16.7	16.5	14.9
Private inventory demand	Mil. tons	11.6	15.3	11.9	14.7	10.9	22.4
Beef production	Bil. lbs.	26.8	28.6	27.7	28.9	29.5	30.4
Beef price	$/cwt.	17.20	19.29	21.90	20.04	22.60	19.09
Milk production	Bil. lbs.	125.9	125.8	124.9	124.2	124.4	127.6
Milk price	$/cwt.	4.12	4.25	4.06	4.47	4.09	4.31
Hog production	Bil. lbs.	18.46	18.36	18.25	19.05	21.37	19.81
Hog price	$/cwt.	17.80	16.89	19.60	16.90	14.10	13.62
Egg production	Billions	60	54	61	57.5	62	59.1
Egg price	¢/doz.	35	31	38	29	31	26.4
Poultry meat price	¢/lb.	19.2	22	19.1	23	17.3	19

per acre in the 1950-54 period to 1.16 tons in the 1958-60 period. Refitting the model including these later years will improve production predictions for future years.

Calculated values for feed grain prices and commercial demand were fairly accurate except that in 1959 the model failed to predict the sharp increase in feed grains consumed. Actual feed grain consumption by livestock increased by about 10 million tons while the model predicted an increase of 1 million. The amount of grain fed per animal unit jumped from .69 tons in the 1957-58 crop year to .73 tons in the 58-59 crop year, even though hog prices averaged $5.00 lower and beef and dairy prices were almost unchanged.

The predictions on deliveries to CCC are correct in direction and fairly accurate as to level but the model badly overestimates the level of private inventories in 1959. This, of course, is commensurate with the underestimation of commercial demand. The price of milk is consistently overestimated and egg prices are underestimated. The residuals for the egg model are serially correlated, and a much more com-

prehensive model is justified for egg prices and production than that given. In general, I feel the predicted values are sufficiently accurate to encourage the use of this model for analyzing the effects of the alternative policy proposals which follow.

Free Market Projections for Feed Grains and Livestock

Three separate policy proposals are examined. The main assumptions are stated for each and the model used to make supply, price and demand predictions. Again it must be stated that so-called predetermined variables are not all known in advance, but some values must be treated as it they were known. A more complete study would attempt to forecast the inventory data for livestock numbers as an integral part of the model. This is not a necessity for forecasts one year in advance, but for hogs and poultry especially, an equation to forecast sows and gilts bred and laying hens held over is essential when four-year forecasts are being made. In these predictions I have used the actual inventories of livestock categories when they were known.

Case I. The model assumptions for Case I are:

1. The elimination of acreage and production controls.
2. The gradual reduction of price supports on feed grains.
3. No CCC releases onto the domestic market.
4. Exports from current production at 12 million tons per year.

Under these assumptions, any decrease in CCC stocks would have to come as an addition to the 12 million tons exported from current production.

Table 7 gives the calculated values for the 1958-61 crop years. By assumption, the support price on corn is reduced from $1.40 in 1957 to $1.15 in 1958, 90 cents in 1959 and 65 cents in 1960 and 1961. For 1958 and 1959, prices of feed grains are assumed equal to the support level. The lowered prices result in production declines for feed grains. The amount fed to livestock increases by about 1 million tons per year and the quantities delivered to CCC decline to about 4 million tons after four years. Private inventory demand doubles from current levels to around 20 million tons. Beef production shows a considerable increase, and prices stabilize in the $18.00 range. Milk production also jumps about 10 billion pounds and prices decline about $1.00 per hundredweight. Pork production remains surprisingly stable, but if additional equations involving farrowings were included it would probably show more variation. Hog prices vary from 11.50 to 15.00 dollars. Egg production is very variable, mainly because the production relation is weak. Poultry meat prices range from 16 to 20 cents per pound.

After a four-year period and with corn prices supported at 65 cents,

TABLE 7. CALCULATED VALUES FOR FEED-LIVESTOCK ECONOMY, CASE I

Variable	Unit	1958	1959	1960	1961
Feed grain production	Mil. tons	155.9	151.6	143.3	141.0
Feed grain prices	1947–49=100	—	—	371	530
Commercial demand	Mil. tons	124.9	125.7	126.9	127.6
Net deliveries to CCC	Mil. tons	15.8	12.3	5.9	3.8
Private inventory demand	Mil. tons	20.5	23.6	22.6	20.7
Beef Production	Bil. lbs.	28.7	31.6	35.0	35.7
Beef price	$/cwt.	19.09	17.62	18.25	18.14
Milk production	Bil. lbs.	133.4	137.3	139.5	138.2
Milk price	$/cwt.	2.89	2.86	3.00	3.16
Hog production	Bil. lbs.	18.0	19.2	18.0	18.6
Hog price	$/cwt.	12.77	11.46	12.96	14.97
Egg production	Billions	75.4	68.8	57.7	62.8
Egg price	¢/doz.	33.1	30.4	24.0	27.0
Poultry meat price	¢/lb.	18.8	15.8	16.6	19.8

deliveries of feed grains to CCC become quite small. No allowance has been made for the reduction of CCC stocks. Exports in excess of 12 million tons would come from CCC, and production of less than the calculated values could be supplemented from CCC stocks.

Case II. The second policy proposal deals with a situation in which price supports are eliminated and deliveries to CCC are nil. An attempt was made to apply these assumptions to the same period, the 1958-61 crop years, but the model would not operate under such a drastic change. The last year included in fitting the model was the 1956 crop year, when feed grain production was 130 million tons. When price supports are eliminated, beginning with the 1958 crop year, when production was 158 million tons, the free market price falls to zero. Refitting of the model to include data through 1960 would help to overcome this problem. It seemed more feasible to begin with the crop year 1956 and carry the program through 1959.

The assumptions for Case II for the feed-livestock sector are:

1. Elimination of price support and loan programs for feed grains beginning with the 1956 crop year.
2. No domestic releases of feed grains by CCC.
3. Exports of feed grains from non-CCC stocks equal to actual exports.
4. CCC reduces stocks by exporting an additional 2 million tons per year.
5. No acreage or production controls.
6. Price supports on wheat at actual levels.

Actual production of feed grains was used for the 1956 crop year and production predicted thereafter. The predicted values (Table 8) may be compared with the actual values given in Table 6 (note calendar years in Table 6). The price of feed grains is estimated to fall about 18 points the first year that supports are eliminated. Commercial demand increased

TABLE 8. PREDICTED VALUES FOR FEED-LIVESTOCK MODEL, CASE II

Variable	Unit	Crop Year			
		1956	1957	1958	1959
Feed grain production	Mil. tons	130.2	124.4	138.8	129.4
Feed grain prices	1947–49=100	55.3	61.3	42.0	63.8
Commercial demand	Mil. tons	123.9	124.8	127.3	130.4
Private inventory demand	Mil. tons	16.7	15.3	19.5	16.0
Beef production	Bil. lbs.	27.9	29.0	29.8	33.5
Beef price	$/cwt.	17.67	17.79	16.01	18.87
Milk production	Bil. lbs.	122.4	119.6	126.0	124.0
Milk price	$/cwt.	4.84	5.13	4.66	5.34
Hog production	Bil. bls.	16.81	16.71	17.2	16.9
Hog price	$/cwt.	12.75	12.18	11.08	12.47
Egg production	Billions	55.9	58.4	51.9	63.9
Egg price	¢/doz.	23.0	23.2	20.5	27.6
Poultry meat price	¢/lb.	16.5	17.0	13.2	16.1

about 6 million tons and private inventory demand by about 5 million tons. Beef production increased about 1 billion pounds in calendar year 1957 although price was very close to the actual. Milk production and prices become much more variable from year to year. (No support program is assumed for milk.) Hog production appears to be quite stable around the 17 billion pound level and prices at around $12 per hundred pounds. As in the previous case, the model should include an equation relating farrowings to feed grain supplies and prices, and to hog prices. Actual inventories of sows and gilts are assumed. Egg prices seem to rest in the 20-25 cent range and poultry meat prices at 13-17 cents.

The price of feed grains becomes quite variable over the four-year period, being inversely related to the production estimates. It reaches a low of 42 after three years and increases to 64 the fourth year. Commercial demand increases consistently even though production varies, and private inventory demand increases 6-9 million tons.

Case III. A third policy proposal was evaluated in which, beginning with the 1956 crop year, the CCC released 7 million tons of feed grains onto the domestic market and exported 2 million tons. In addition, wheat supports were dropped 20 cents per bushel per year beginning with the 1956 crop year. Assumptions 1, 3, 4 and 5 also held as given for Case II.

The results were chaotic. In the first year the free market price of feed grains fell from an index of 75 to 30 and almost to zero the second year. Beef prices remained at the $17.00 level the first year and then fell to $15.80 the second. Milk prices dropped from $4.12 to $3.90 to $2.70 and hog prices from $17.80 to $10.96 to $9.75. Even though sizable statistical errors are involved, the only conclusion which I can draw is that given the level of feed grain production we had in 1956 (130 million tons and a

calculated value for 1957 of 140 million tons) any program which entirely eliminated price support programs would have caused extreme price declines for feed grains and livestock.

Conclusion

In conclusion, let me again state that I believe econometric models can be useful as policy tools but they must be designed for specific purposes and supplemented by the knowledge of specialists in commodity areas. It is necessary to actually apply models, note where the weaknessses occur and reformulate them to overcome such weaknesses. They should be brought up to date as new data become available. They are not a substitute for persons who have a thorough knowledge of a commodity area but should rely upon such persons for aid in constructing realistic equations, and then results from both sources should be checked to see where, and why, inconsistencies occur.

DISCUSSION: CONTRIBUTIONS OF ECONOMETRICS TO FARM PRICE AND INCOME POLICIES

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Perhaps the authors of these three papers should not be held responsible for an assumption one might have made when looking at the general title of this session that here we would have an appraisal of how much of a contribution econometrics has made to policy decisions. It is likely the authors were merely asked to describe recent studies made by them and perhaps then the chairman devised a title or umbrella which would cover them. But the question is relevant and I would like to talk around it for just a bit.

There is and has been an urgent need for information about the probable consequences of alternative agricultural policy decisions. Econometrics has a terribly important role to play in this process. Unfortunately, it probably is not capable of quickly providing a very precise basis for judgment on many of these issues. This is due not only to certain weaknesses in the necessary data and methodology, but also is often compounded by certain difficulties in bringing relevant conclusions out in the open in spite of their weaknesses.

I would like to point out that the first two of these three studies, which have caused the most public discussion, came at the request of some person or group and not because researchers felt a compulsion to call public attention to conclusions flowing from their econometric analyses. Perhaps it is too much to expect that the U.S. Department of Agriculture in

recent years would on its own, have initiated and published results such as those contained in Senate Document 77. But to me, here is a serious weakness. The U.S.D.A. is the repository of more resources capable of being brought to bear and giving good answers to such questions than any I know of. Yet, it took the request of a Senator to bring forth this material.

Perhaps the Iowa group would have done their study without being spurred by interested farmers, but likely not so soon. Now that it has been done, and some of the consequences felt, I am sure that these researchers have a stronger appreciation for the virtues of academic freedom and possibly also of its responsibilities. But the unfortunate destructive criticism of "rigged assumptions" is certainly little incentive for serious-minded students to pursue such studies with enthusiasm. It is to the credit of Iowa that such attacks have been firmly rejected.

I think this all points up the need for better arrangements where econometric studies with policy implications are encouraged on the part of those best equipped to do them, and for assurance that attempts at reprisal by special-interest groups may be thwarted.

Now for some comments on these studies.

Perhaps most important, it should be noted that these studies are in essential agreement on the fact that removal of price support programs would have very grave price and income consequences for farmers. In fact, the probable consequences of such a course are so grave that a positive policy including this element probably would be rejected by most of those in positions of responsibility.

But, in addition, these studies point up the continuing importance of agriculture's supply problems in the years ahead. In fact, this supply potential seems to be so large that if it were to continue unchecked the probable price and income consequences would be so far outside the range of recent experience that it is difficult to predict how farmers might react to these drastic conditions.

As if this were not enough, there is basis for the belief that some of these projections still contain a somewhat optimistic bias. In this connection, we should note the importance of the yield assumptions which have been employed, particularly those in the Department's study. Rojko and Randall touch on this briefly, but it bears re-emphasis; namely, the yields projected for 1965 have already been achieved for several of the major crops in the three years 1958 to 1960. Attributing high yields in these successive years to good weather puts quite a strain on my view of good logic.

On the demand side, the crucial role played by disposal activities like Public Law 480 emphasizes the part which special measures inevitably must play in striking a desirable balance between demand and existing

supplies in terms of reasonable prices. But in addition, one must continue to keep in mind the fact that the assumptions, particularly in the U.S.D.A. and Iowa studies, still include a considerable element of governmental activity, such as, for example, The Sugar Act, International Wheat Agreement, School Milk and School Lunch Programs and other measures. Thus the so-called free market conditions assumed are not really free in the sense that some people would propose.

It has been hard for me to tell what the contribution of econometrics has been by looking either at Senate Document 77 or the paper reporting the Iowa study. In each case (particularly the U.S.D.A study), the details of analysis are not well spelled out, and consequently it is difficult, if not impossible, for an outsider to check the work except in a general way. Furthermore, reference has repeatedly been made to the role of judgment in arriving at conclusions in each of these studies. It apparently has not yet been possible to devise mathematical models which include all relevant and necessary assumptions and variables in order to determine the necessary interrelations and the consequences of hypothesized actions. The need to rely on the judgment of the commodity specialists for particular commodity consequences of policy actions still leaves much to be desired in this type of study. So there is not much basis for appraising many of the study details. Such an appraisal really amounts to specifying one's degree of willingness to accept the judgment of the particular commodity specialists involved in the over-all analysis.

These studies show in their conclusions the drastic consequences which would flow from an extreme public action, that is, removal of price support in a context of rapid growth in agricultural output. I suggest that we should not have been surprised by such conclusions. However, and perhaps more importantly, it remains to be seen what this type of analysis can contribute where analyzing and appraising alternatives whose consequences are somewhat less obvious; consequences of program proposals which are somewhat less extreme.

The U.S.D.A. and the Iowa studies represent an approach involving the aggregation into an over-all whole of the several partial equilibrium analyses, while the Cromarty model is general in that it includes the major elements in the agricultual economy and their major interrelations in an integrated system. The logic of this approach holds more appeal for me, although I am disturbed by its rigidity and apparent weakness in revealing longer run consequences of policy proposals.

During the course of review of the progress of the U.S.D.A. study, the Committee of Land Grant College Economists had some misgivings about the conclusions reached in view of the approach used by the U.S.D.A group. Specifically, there was some doubt that a simple adding together of the results of a series of partial equilibrium analyses would give an ac-

curate reflection of the aggregate consequences of the assumptions. This doubt rested primarily on the belief that the procedure required is really different than that ordinarily followed by commodity specialists. This study could not assume that other segments of the agricultural economy are held constant for a given commodity analysis, which is what commodity specialists usually do. The situation really is one in which supplies of *most commodities* are increasing and most prices declining simultaneously. Consequently, the usual possibility that price declines might be mitigated by substitution effects is much reduced. The Committee reviewing the work of the Department was not convinced that adequate consideration had been given to this possibility and it felt that even the drastic price declines which were projected were possibly on the optimistic side.

The Iowa study attempted to make successive year by year estimates of each of the relevant variables and called attention to the difficulty of spelling out the cumulative effects of the course of events proceeding through time. Programs which continue for a number of years will inevitably generate effects which become cumulative with the passage of time, but which in any single year may have relatively small impact. Furthermore a number of the possible consequences of given program actions often take a significant number of years to reveal themselves in significant effects. Thus, for example, the effect of a prolonged period of low prices on projected yields may be a very complicated one. Shifts in acreage may lead to diversion of some of the poorer land to other commodities, thus tending to increase these yields. But at the same time low prices may reduce the incentive to apply fertilizer at usual rates, thus tending to reduce yields. In the face of these divergent forces proceeding perhaps at different rates, it becomes very difficult indeed to project with any certainty the consequences of the effect of low prices on yields over a period of years. Similarly, prolonged farm depression may affect significantly the rate of farm enlargement and thus have an influence on the course of output. Elimination of the price support programs and the consequent increase in uncertainty regarding future prices will also lead to changes in production. But here again our econometric analyses have not been very helpful in specifying the effect of varying degrees of uncertainty on subsequent output, even though most economists are convinced that uncertainty is an important element in farm planning and production.

Finally, it should be pointed out that none of these studies attempts to bring down to the individual farm level the consequences of their price, income and production projections. While this may be one of the most serious shortcomings of the studies, I am sure that in view of the difficulties faced by the researchers, they can be pardoned for this omis-

sion. But it is a well-known fact that agriculture is undergoing dramatic changes in farm numbers and farm organization. While conclusions about the total flow of money payments to agriculture for agricultural products and the projected levels of agricultural output are basic to many policy decisions, it is important to extend the appraisal of these projections in light of the number and size distributions of farms and farmers. Many decisions about farm policy will be based upon the impact on individual farms and not upon aggregate numbers. When set in this context, it may be that the output and income changes projected will still be dramatic, but a little less so than when viewed from an aggregate standpoint.

We should all be grateful to these researchers for having embarked on a very difficult analytical task. While refinements can be expected in their procedures and basic data, further applications should not be delayed. We must do the best we can with what is at hand and exercise appropriate caution. I believe I detect in the developing political climate an increased willingness to call upon economists for econometric analyses of the consequences of alternative agricultural policy proposals. We will not be prepared to deal with questions which are raised unless we pursue such studies with increased vigor. Those presented here should serve to stimulate this work.

DISCUSSION: CONTRIBUTIONS OF ECONOMETRICS TO FARM PRICE AND INCOME POLICY

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To certain gentlemen newly arrived in the capital of our nation who are charged with making farm policy in the fateful days that lie ahead, the findings of the econometric analyses reported in the three papers just read will hold an uncommon interest. Those reports, as well as similar studies, such as a 4-part work recently released by the Joint Economic Committee of the Congress,[1] will be regarded as statistical portraits of the farm economy describing either the Elysium to be sought or the Erebus to be avoided. To econometricians, the studies are an exhibit demonstrating the versatility of the technique they embody, and therefore testifying to the right of the authors to hold practitioners' licenses. To a discussant who is neither politician nor econometrician, the studies invoke interest but not rhapsody; are persuading but not convincing; and

* These comments are the author's and do not necessarily reflect a position of the Council.

[1] *Economic Policies for Agriculture in the 1960's: Implications of Four Selected Alternatives*, Joint Committee Print, 86th Cong., 2d Sess.

are a sign of gratifying progress but not of conclusive achievement in identifying and quantifying the economic forces that mold the farm economy.

These studies feature a statistical intricacy made possible only by the super-cerebral speed of electronic computers; yet their outstanding contribution and distinguishing characteristic is not analytical but communicative. They are an educational device, and a good one. The difficulty of translating even simple economic concepts for popular comprehension is familiar to almost every practicing economist. A multi-equation model for the total farm economy cannot possibly be communicated widely as an abstraction, nor in the familar figures of economic speech. Probably the only communication device of promise is the one utilized in the three papers. Each of the studies consists essentially of one or more hypothetical spot readings of output, price, income and other measures of the farm economy at specified points in time and under specified external conditions. Each is constructed so as to answer the question, "What would happen to the farm economy in year ____ if ________ conditions were to prevail?" The blanks are to be filled in for each case. In the three papers several different years and several phrases specifying governing conditions were inserted. Stated differently, the three studies present cross-sectional descriptions of the farm economy arrived at under stated assumptions, and they constitute the only device by which statistical model-building for agriculture can be made comprehensible to a wide audience.

In the magic of electronics the limiting factor is not capacity of computation but expertness of programming. Moreover, neither the electronic machines nor mathematical concepts can compensate for any deficiency in underlying economic theory and understanding. The authors of the three papers are faithfully aware of this maxim. They dot their text with admonitions to caution. Yet, I think they doth protest too much—or at the wrong place. Especially do they overstate their concern for the possible error in their general equilibrium equations that may arise from reliance on coefficients of elasticity of demand obtained from demand studies for individual commodities. They especially deplore a lack of reliable data for cross-coefficients of demand elasticity. This concern seems misplaced. The analytical weakness in these studies is not on the side of demand but of supply. It is in demand analysis that the storehouse of analytical experience is most ample. And I would say to those of you who subsist in a universe of masonry and glass and diluted carbon monoxide, and who have no closer contact with the soil than seasonal purchase of a potted poinsettia—yet who for classroom demonstration of viable economic principles habitually draw on illustrations from the farm economy—to you I would declare that the chief message of these studies is their reve-

lation of a limited role for demand. For these are essentially demand-oriented studies; and their major outcome is the evidence that demand will not absorb readily the added supply of farm products that would be thrown on the market if the farm-production Prometheus were to be released from his bonds. Instead, a material and unwelcome price decline would result. This conclusion has its deepest meaning for economists of my generation, who pursued our school-day lessons during the episode of an overwhelming business cycle. We learned then of the robust price-making power of a cyclically-fluctuating demand. The present studies of the farm economy, conducted in a new era, tell us that demand is a much less influential factor when generated during secular economic growth at high employment. Nowadays most of the consuming population in this country is so sated if not jaded, so well-fed if not over-fed, that both income elasticity and price elasticity of demand for farm products are quite small. This is discouraging to those who would try to use farm productivity for humanitarian ends without creating an unhumanitarian depression of prices and incomes to farmers. Acceptable market outlets for a substantially expanded farm output apparently are not to be found.

The obvious and inescapable conclusion is that during periods of nearly full employment the supply side of the price-making equation for farm products begins to overshadow the demand side. It becomes ever more controlling. The authors of these papers are properly apologetic for the embryonic state of supply analysis in agriculture. They talk in terms of trend analysis and adoption of known technology and so on, but what they really say is that there is so much inertia in the supply-making forces that supply becomes highly predetermined for the shorter run. This is a simplifying assumption, and doubtless the only course open to them. But it leaves unanswered the larger question as to what would happen if enough time were allowed for sizable supply adjustments to take place. And when statistical model makers face up to the necessity of introducing a longer-run supply response, they will find the classical conceptualization to be terribly out of date. No longer are supply forces in agriculture to be delineated in terms of a Ricardian farm economy framed by fixed land resource and semi-fixed farm labor—one in which a theory of rent is outlined by the variability to be found in natural productivity and in returns to successive labor and capital inputs on land of any given productivity. Samuelson says this should be regarded as formulating a "land theory of value."[2] Diminishing return from added labor or from recourse to poorer land doubtless was regarded as conducive to stability and limited responsiveness in agricultural output. The Ricardian concept

[2] Paul A. Samuelson, "A Modern Treatment of the Ricardian Economy." *Quar. J. Econ.*, Feb. and May 1959.

of the agriculture of his day must be replaced by a modern concept. Of the resources used in modern agriculture, only about 35 percent are land and family labor. About 65 percent are purchased inputs, most of which are of nonfarm origin, are characterized as relatively "variable," and are available to agriculture in an almost perfectly elastic supply. How this kind of farm economy would function given time for full equilibrium adjustment to take place is the fundamental question facing politicians, econometricians, and the unlabeled rest of us. The studies reported on today may well be the forerunner and prototype for the even more venturesome studies needed in the future to help resolve that dominating issue.

LINEAR PROGRAMMING APPROACH TO THE SOLUTION OF PRACTICAL PROBLEMS IN FARM MANAGEMENT AND MICRO-AGRICULTURAL ECONOMICS*

CHAIRMAN: GLENN L. JOHNSON, MICHIGAN STATE UNIVERSITY

PROGRAMMED SOLUTIONS TO PRACTICAL FARM PROBLEMS

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THE general theme for this session suggests that we are to take a pragmatic view of the contribution of linear programming in agriculture. In particular, we are to indicate the contribution of linear programming to the management of individual farms. Whether a particular application is practical depends on whether it accomplishes a desirable result from the standpoint of the user. If we arrange users in a continuum ranging from the commercial farmer to the academic researcher, it will be in keeping with the spirit of the title for this session to emphasize those applications at or near the commercial end of the range. We shall therefore not treat explicitly the contribution linear programming has made as an analytical device in the research process and the indirect effect of the subsequent increase of knowledge on the operation of commercial farms. Rather, we shall present evidence of the direct application, by private and public agencies, of the technique itself to commercial farms. We shall also mention a contribution of the *concept* of linear programming that is quite apart from its direct commercial or extension application. This is the impact of the logic of linear programming on conventional farm planning procedures.

Commercial Applications

It is in the commercial context that decisions on whether to employ programming involve the type of "cost vs. expected returns" calculations that, to many persons, would make "practical application" the equivalent of "commercial adoption." In spite of a voluminous list of agricultural "applications" of linear programming, one finds virtually no documentation of commercial applications.[1] One of the pioneering efforts in commercial

* Joint Session with the Econometric Society. Mr. George B. Dantzig, The Rand Corporation, also participated but did not prepare a formal paper for publication.

[1] The titles of articles are quite misleading in this respect. Many titles (my own included) may create the impression that the linear programming solutions that have been developed have, in fact, been adopted by commercial farms. Upon closer exami-

application of linear programming to farm management is being made by Doane Agricultural Service in St. Louis, Missouri. This organization is actively engaged in two types of commercial services involving linear programming. The first is the development of farm management plans for the farms of individual clients. The second is an area development study in which linear programming is used only to develop optimum plans for typical farms within the area. We shall discuss only the first kind of application.

In the individual farm type of service, about ten farms have been programmed since the firm began to offer this particular service about two years ago. The staff assigned to prepare a linear programming solution for the client visit the farm and, with the owner, ascertain the desired objectives of management, fixed resources, and other characteristics relevant to development of the plan. In the choice of the coefficients in the enterprise budgets (activities or processes), the judgment of the local Doane representative is accepted. These representatives are engaged in professional farm management of the traditional type and are familiar with agricultural production in their area. Prospective prices are provided by the consulting firm's price research section. Although some aspects (e.g., building and machinery because of divisibility difficulties) usually are not explicitly considered in the model, most of the recommendations in the final detailed report are based on the linear programming solution.[2] The cost of such a plan is sufficiently high (from $1,000 up) that the existence of this market can hardly be written off as a promotional scheme.

The existence of a market in farm plans developed by linear programming attests to the practicality of the technique. The programmed farms have, of course, all been rather large operations. It is likely that the expense involved in developing a farm plan by this technique is not very closely related to the size of the operation. Thus, if the clients expect

nation, we find that the solutions apply to typical (in most cases, hypothetical) farms and that the principal purpose of the work has been to analyze relationships within the firm. For this purpose, the various forms of parametric programming have been useful additions to the early models. Another characteristic of the literature is that it is becoming increasingly difficult to locate, on the basis of titles, research studies that employ the linear programming technique. This is a welcome indication that the technique is being subordinated to the problems that are being analyzed.

[2] Developments in integer programming will permit some of the aspects of building and machinery selection to be integrated into the programming model. The inadequacy of conventional linear programming to handle these lumpy inputs, whether they are presently on site or are to be purchased or sold, will become more pronounced as farms become larger and assume more of the characteristics of an industrial plant. For an example of an important type of agricultural problem in which integer-solution methods are, in general, required, see Peart, Robert M., "Optimizing Materials Handling Systems by Mathematical Programming," unpub. Ph.D. thesis, Purdue Univ., 1960.

to increase their income by a percentage that is more or less independent of the size of operations, we should expect to see the commercial applications expand as farms get larger and also, of course, as the consulting firms obtain more experience and are thus able to lower their fees.

A more extreme development in the commercial adoption of linear programming would occur in very large farming operations where only the computational aspect of programming is contracted and the management staff of the farm itself develops the model. An example of this type is the Kern County Land Company in California, which has developed least-cost feed rations for use in its own feeding operations.[3] The company nutritionist specifies the standards to which the ration must comply. The initial savings have amounted to approximately $6.00 a ton. At first the calculations were performed monthly, but since the initial cost was reduced, the reprogramming has been done only intermittently. Although this example involves an integrated operation, there are numerous other examples in the feedmixing industry itself.[4]

These examples indicate that linear programming has made a modest, but significant, beginning in its commercial application to individual farms. We expect the process to accelerate.

Extension Applications

Linear programming has been used in the agricultural extension activities of the various states mainly in the form of optimum plans for typical hypothetical farms.[5] The usefulness of such a procedure depends on developing appropriate procedures to apply the typical farm solution to the individual farm under consideration.[6] My impression is that the impact of these optimal benchmark plans on the planning of commercial farms has been minimal. To successfully modify a solution for a typical

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[3] It is not surprising that linear programming is being used commercially in the livestock feed-mixing industry. The diet problem was the first economic problem solved by use of this method. This type of problem was formulated and solved by a method other than linear programming in Stigler, G. J., "The Cost of Subsistence," *J. Farm Econ.* 27:303-14, 1945. It was later (1947) solved by Dantzig and Laderman by the use of linear programming.

[4] See "Electronic Feed Formulation—A Progress Report," *Feeds Illustrated*, July 1960, pp. 16 ff.

[5] In 1957 Richard A. King summarized the agricultural applications by public agencies in an unpublished paper, "Programming Better Farm Plans," presented to the Association of Southern Agricultural Workers February 4, 1957. A more recent survey and bibliography have been released by Eisgruber and Reisch of Purdue University. See also McAlexander, R. H., and Hutton, R. F., *Linear Programming Techniques Applied to Agricultural Problems*, Pa. State Agr. Expt. Sta., AE and RS No. 18, 1959.

[6] Graphs indicating sensitivity of plans to price, resource, and coefficient changes are aids to making such modifications. To help small feed mills modify a general solution to fit their own situation, Robert Hutton of Pennsylvania State University is currently using the "Complete description" method. To my knowledge, this method has not been tried for the farm plans developed by linear programming.

farm to fit a new situation requires that the planner be reasonably familiar with the programming technique as well as with the agriculture of the area. Many potential users of plans for these benchmark farms do not have these qualifications. Further, actual farms can frequently be found that closely approximate the programmed solution, and demonstration of results on these farms is much more effective in inducing change on the part of other farmers than are optimal solutions of typical hypothetical farms. Thus, it might be argued that programmed solutions have little value. In reply we should point out that our understanding of *why* successful farms are successful is enhanced by articulation of the relationships among the variables as required by the programming model. Such an understanding is prerequisite to making recommendations.

Programming of individual farms by the Extension Service is presently being done on a very limited basis.[7] In some instances solutions are used as teaching devices to stimulate thinking and discussion in group meetings. The most ambitious project of an individual farm planning nature has been carried on in North Carolina.[8] Individual plans were developed for the 45 farms in the Parker Branch watershed. Several alternative plans were presented to each farmer after an initial optimum program had been developed. The alternatives permitted closer tailoring of the plan to individual preferences than might have been possible if only a single plan had been presented, based on a farm visit previous to the actual programming calculations. The initial solution was explained to the farmer, with emphasis on the assumptions that were involved. Later visits included a discussion of alterations in the original solution that might be more realistic and/or desirable. This discussion, in turn, led to either reprogramming or adjustments by partial budgeting to obtain a solution that was more acceptable to the farmer.

Among others, R. J. Becker in extension farm management at Pennsylvania State University has employed the technique on an individual farm basis. His estimates give an idea of the resources involved to do a reasonably good job of individual farm planning.[9]

1. Two full weeks of a person experienced both in linear programming and the agricultural production of the area. This includes time for the visits to the farm to get data, to develop the model, to edit the solution, and to discuss the solution with the farmer.

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[7] Extension application of linear programming to individual farms has been reported by six states. (Letter to author from Buel Lanpher, Chief, Farm Management and Production Economics Branch, Federal Extension Service, October 18, 1960.)

[8] Coutu, A. J., and Bishop, C. E., "Relations of Farm Resource Use to Farm Family Incomes and Hydrology in the Parker Branch Watershed," Chap. 26, *Fertilizer Innovations and Resource Use,* ed. by Baum, E. L., *et al.*, Iowa State College Press, Ames, 1957.

[9] Personal Communication, September 23, 1960.

2. Approximately $60 of computer time.

If additional overhead expenses were included, it is likely that the outlay would be in the neighborhood of the fees for the linear programming plans developed by the consulting firm mentioned above. Some standardization of procedure and data is, of course, possible. This would reduce costs but might decrease the applicability of the results if there was considerable variation in farm-to-farm requirements. If one views the chief extension activity as one of adult education, it would seem that only the more opulent states could afford an individual farm planning service involving linear programming. However, where record-keeping associations are in operation, with the participating farmers bearing the cost, a linear programming service might be viewed as a logical extension of present activity.

Effect of Linear Programming on Conventional Budgeting

There is considerable evidence that linear programming has inspired changes in the planning and budgeting methods that have traditionally been used. Half a dozen of these variations are mentioned below; there are no doubt others. The first, and perhaps the simplest, is that of E. Hartmans.[10] This method requires that the planner decide which of the two resources, land or labor, will first limit farm profit. Ideally, research on actual operating farms is used to help make this decision. After the more limiting resource has been chosen, enterprises and combinations thereof are chosen to maximize return to this limiting factor. In linear programming terminology, we have only one row in the technology matrix. Of course, in actual use, the judgment of the planner is injected at various stages to, for example, impose certain technical limitations on enterprise size that are not directly related to the limiting resource.

A more completely developed planning procedure, with a detailed example, has been presented by Clarke and Simpson in England.[11] In this paper the authors explain the relation between what they term "programme planning" and linear programming. They also compare the results of their method with a linear programming solution on the same farm and find virtually no difference in the expected profit.

Bishop and Toussaint[12] have presented a planning method that follows

[10] *Farm Management in the United States,* The European Productivity Agency of the Organization for European Economic Co-operation, Paris, 1958, pp. 46-57.

[11] Clarke, G. B., and Simpson, I. G., "A Theoretical Approach to the Profit Maximization Problems in Farm Management," paper presented to the Agricultural Economics Society, Dec. 1958. For a critique of this method see Candler, Wilfred, and Musgrave, Warren F., "A Practical Approach to the Profit Maximization Problems in Farm Management," *J. Agr. Econ.,* 14:208-22, Dec. 1960.

[12] Bishop, C. E., and Toussaint, W. E., *Agricultural Economics Analysis,* New York: John Wiley and Sons, Inc., 1958, Chap. 12.

the linear programming format. They constructed enterprise budgets (activities in a linear programming model) that could just as easily be used in the first tableau of a linear programming problem. They suggest starting with the one enterprise that yields maximum net revenue with the given resources, then adding complementary and supplementary enterprises and, finally, comparing, by trial and error methods, the effects of changes due to the introduction of other enterprises.

Hinton[13] has developed budgets for several enterprises in which incomes over direct costs are calculated. To guide the choice of enterprises, a calculation is made of the number of units of each enterprise that are possible from each limiting resource.

Swedish workers[14] have developed a more elaborate method, although informal from a mathematical viewpoint. They describe a method for developing a "contribution" for each enterprise. It is essentially revenue minus costs specific to that enterprise. The scheme for selecting enterprises uses the standard simplex tableau, but not the simplex algorithm. Like the other methods described, the enterprise chosen first maximizes return to the fixed resources. Additional enterprises are chosen by judgment and alternative plans are compared. The authors report that the method was developed principally for use by farm advisers and consultants.

Finally, Weinschenck[15] has reported a similar method developed in Germany. His method starts with the existing form of organization and first determines a short-run optimum, given the fixed resources and considering only the present enterprises. Next he considers a somewhat longer planning horizon, with the possibility of adding new enterprises together with their required capital. His long-term optimum considers labor also to be a variable resource. His format for enterprise selection again resembles the simplex tableau. He concluded that, in his experience, the relationships among the enterprises are very rarely complex enough to warrant use of the simplex procedure.

The recent changes in practical farm budgeting procedures are in large respect directly traceable to the familiarity of research and extension workers with linear programming. Of course, the modified methods do not have the power and rigor of linear programming, but they do bear its impression and, in terms of application at the farm level, are more practical. At the present stage of development, this contribution of linear pro-

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[13] *Farm Management Manual*, Dept. of Agr. Econ., Univ. of Illinois, AE-3349, 1959.

[14] Johnsson, Holger, Renborg, Ulf, and Säfvestad, Vikar, *Resultatmaximering i lantbruket*, Meddelande från Jordbrukets, Utredningsinstitut, Nr. 3-59, 1959.

[15] Weinschenck, Günther, "Programme Planning With Particular Stress on Experience in Germany," unpub. paper presented at Oslo conference of O.E.E.C., Sept. 1960.

gramming toward more systematic farm planning procedures is viewed as an important one.

Concluding Remarks

My task in this paper has been to indicate the practical application of linear programming in agricultural production. When one considers the relatively large number of small firms in agriculture compared with other industries, as well as the rather short period in which linear programming has been available, the extent of commercial and extension applications appears substantial. Its competitor in practical application is the more or less informal method of planning presently being used. No instances have been reported in which a total commercial farm has been planned by using the formal optimizing technique implicit in traditional marginal analysis.[16] There are a few gadgets on the market, based on fitted production functions, that give minimum-cost or maximum-profit solutions under various price and/or other conditions for an organizational unit within the farm. Also, nomographs based on production functions have been used in making extension recommendations. However, these are sub-optimization procedures in that they deal only with an enterprise or technical unit within the farm and not with the organization of the total farm. The operational advantage of linear programming over traditional marginal analysis in total farm planning stems chiefly from the fact that its data requirements more closely correspond to the kinds of information presently available for planning.

[16] Dorfman, Samuelson, and Solow have pointed out: "It would be misleading to contrast the linear programming model with marginal analysis in general. Linear programming *is* marginal analysis, appropriately tailored to the case of a finite number of activities. 'Traditional' marginal analysis is tailored to the case of a differentiable production function." *Linear Programming and Economic Analysis,* McGraw-Hill Book Co., New York, 1958, p. 133, fn. 1.

SHORTCOMINGS IN PROGRAMMED SOLUTIONS TO PRACTICAL FARM PROBLEMS[*]

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THERE are several serious shortcomings in the programmed solutions to practical farm problems. These shortcomings occur at various stages in the programming process from the initial recognition of the problem to the implementation of the recommended solution.

The framework for analysis is one in which the shortcomings of linear programming are classified according to their origin. Some of the shortcomings originate in the mathematics, some in statistics. Others are traced to the economic theory underlying specific applications. The most serious shortcomings appear to originate in the programmers themselves. Not all of the shortcomings discussed are peculiar to linear programming analysis. Some of them are shared with other methods such as functional analysis.

The Shortcomings

Mathematics

The most important mathematical shortcoming of linear programming relative to related computational methods such as functional analysis is the linearity imposed on the restrictions. Linearity is the price we have paid for a method which handles more variables than functional analysis for a given amount of computational effort and which conveniently incorporates inequalities and slack variables allowing for more realistic statements about certain aspects of the farmers' environment.

To forego the use of non-linear restrictions is of considerable importance in analyzing some economic problems involving diminishing returns and imperfect competition. It is of minor importance where there are constant returns, as in feed mix problems. This shortcoming has not always been satisfactorily overcome by approximating non-linear restrictions with a series of line segments. It will be overcome when we have worked out a satisfactory computational method for non-linear programming in which some regular function $Q = \psi(X)$ is maximized subject to the linear inequalities $AX - \mathrm{b} \leq 0$, where the decision variables (X) are non-negative. This improvement in the direction of non-linear analysis is just around the corner and will subsume all linear programming directly. It will subsume other functional analysis as well, because non-linear

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[*] Journal Manuscript No. 636 of the Oklahoma Agricultural Experiment Station.

[**] I have queried each of the fifty agricultural economists who have published on linear programming in the *Journal of Farm Economics* since Frederick Waugh's article on the minimum cost of dairy feed appeared in August, 1951, and I am indebted to my respondents for making the scope of these criticisms greater than they would have been otherwise.

production functions may be substituted into the criterion equation. The linearity shortcoming will soon be of interest only to historians.

The continuity assumption for variables which may take only integral values was a recognized source of difficulty in programmed solutions of the past decade. Two recent developments have corrected this shortcoming. Computational methods for handling fixed charges are used to assess the profitability of introducing an activity into the solution for which average total cost is greater than average variable cost.[1] Integer programming provides solutions using whole tractors and whole cows rather than fractions thereof.[2]

Statistics

Programmers have not been using statistics to provide measures of significance of the results or to analyze elements of risk in the farmer's environment. They have not used statistics enough in arriving at reliable input-output coefficients.

The existence of tests on the significance of the results of linear programming follows from the theorem that a random variable has normal distribution if it is a linear function of normally distributed independent variables. The existence therefore depends only on the distributions appropriate for the input data. Perhaps application of this theorem has proven itself impractical, or perhaps confidence intervals resulting from the procedure would be too wide to be useful even when the results are, in fact, reasonably accurate.[3] The value of programmed solutions to practical farm problems would be greatly enhanced if, with each solution, we provided statements about the statistical significance of the results. We might provide a statement, for example, of the 90 per cent confidence interval over the criterion, given the expected values of the random variables in the programmed solution;[4] and we might state the probability that an application of the proposed solution would not require more resources than are provided for in the restrictions.

The unreliability of some programming coefficients is a statistically rooted shortcoming. Just as a chain is no stronger than its weakest

[1] Harold Giaever and James Seagraves, "Linear Programming and Economics of Size," *J. Farm Econ.*, Feb. 1960, p. 103.

[2] George B. Dantzig, "On the Significance of Solving Linear Programming Problems with Some Integer Variables," *Econometrica*, Jan. 1960, p. 30. See also, A. H. Land and A. G. Doig, "An Automatic Method of Solving Discrete Programming Problems," *Econometrica*, July 1960, p. 497.

[3] Boles *et al.* mention confidence interval estimates that are too wide to be useful in "Use of Linear Programming to Estimate Population Parameters," *J. Farm Econ.*, Nov. 1959, p. 814. This article is a good lesson on how to wag a dog with his tail, because it demonstrates that parameter estimates can be the product of, rather than inputs to, the programming process.

[4] This problem is discussed by M. M. Babbar in "Distributions of Solutions of Sets of Linear Equations," *J. Amer. Statistical Assoc.*, Sept. 1955, p. 854.

link, so a programmed solution is no more trustworthy than the accuracy with which one arrives at the input-output relationships, prices and activities. It is at this stage in the programming process that temptation is maximized by the appeal of time-saving guesses, of thoughtless aggregation of inputs and of perjury. Mistakes made at this early stage of the programming process are the hardest to detect in the final analysis.

Insurance and gambling strategies for farmers in response to probability distributions over weather and prices have not been included in the programmed results to practical farm problems over the past decade. This shortcoming is common to other methods of analysis and is a reflection of the fact that we do not have the mathematical statistics of dynamic economics sufficiently developed yet. When the parameters of programming problems are random variables, we have stochastic programming.[5]

Economics

The shortcomings of linear programming which orginate in the underlying economic theory have to do with the static nature of the theory used and with difficulties of aggregating micro-economic results into macroeconomic relationships. Linear programming shares these shortcomings with other related methods of analysis.

Let us distinguish between shortcomings resulting from inadequacies in the existing body of economic theory and those resulting from failure of programmers to conceptualize important problems within the framework of that theory. We are concerned with the former source here and will treat the latter source in the discussion of shortcomings originating with the programmers themselves.

While static economic theory is of great value in isolating important relationships in farmers' problems, there usually remain some aspects of the problems unaccounted for. That is, there remain some dynamic elements involving imperfectly known changes over time.

When we define dynamic models after the fashion of J. R. Hicks as those in which variables are dated, and when we retain the usual static assumption of perfect knowledge, dynamic problems are relatively easy to conceptualize in relation to well known growth models or discounting models as long as we are willing to assume answers to questions about future values for exogenous variables.[6] Shortcomings in these applications depend on the reliability of our guesses of the future and on the difficul-

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[5] Gerhard Tintner, "A Note on Stochastic Linear Programming," *Econometrica*, April 1960, p. 490.

[6] See Laurel D. Loftsgard and Earl O. Heady, "Application of Dynamic Programming Models for Optimum Farm and Home Plans," *J. Farm Econ.*, Feb. 1959, p. 51, for a method which handles known or knowable changes over time. A method for tracing through knowable changes in a timeless model is discussed by Thomas E. Tramel and A. D. Seale, Jr., in "Reactive Programming of Supply and Demand Relations," *J. Farm Econ.*, Dec. 1959, p. 1012.

ties of allowing for interaction between decision variables and exogenous variables over time.

When we define dynamic models after Frank Knight as those in which either present or future values for some variables are imperfectly known, dynamic problems are relatively difficult to conceptualize and will remain so until we make some needed improvements in dynamic economic theory.

Programming has not dealt adequately with problems involving imperfect knowledge. When we know probability distributions explaining values which uncontrolled variables can assume, we need dynamic economic theories involving maximization of expected values.[7] Not until economic theories explaining rational economic behavior under risk or uncertainty are related to models involving growth or discounts over time, and not until computational methods are worked out for solving such problems, will we be able to overcome the shortcoming in programmed solutions to practical farm problems originating in the static nature of the theory used.

Economic theory does not tell us all we need to know about micro- and macro-economic interrelationships. For example, in dairy production we may conclude from programming of representative dairy farms that the quality of cattle should be upgraded and the size of herd increased for maximum profits. To contradict these output increasing recommendations, we may conclude from a macro-economic study of the industry that present total milk production is enough to meet the demand at present prices and that with an inelastic demand for milk any appreciable increase in output may be disastrous.

Studies on interregional competition have cast much light on macroeconomic problems, but we need an economic theory which will tell us which firms should expand, which should remain as is, and which should go out of business entirely as far as the best interests of the individual operator are concerned.[8] We have written enough bulletins on how to get started in farming—it is time we did some research on how to stop. We can do so when we have integrated these micro-economic relationships into a meaningful macro-economic theory of industry behavior.

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[7] This goes beyond simple stochastic programming where random shocks are incorporated in the model. The solution which maximizes the criterion function given the expected value of random variables is not necessarily the one which maximizes the expected value of the criterion function. See A. A. Walters, "Expectations and the Regression Fallacy in Estimating Cost Functions," *Review Econ. and Stat.*, May 1960, p. 210.

[8] Glenn L. Johnson, "Supply Function—Some Facts and Notions," *Agricultural Adjustment Problems in a Growing Economy*, ed. by Heady, Diesslin, Jensen and Johnson, Iowa State College Press, Ames, Iowa, 1958. See also, Glenn L. Johnson, "Some Basic Problems for Economists and Statisticians Arising from U.S. Agricultural Policies," *Manchester Statistical Society*, Manchester, England, Nov. 1959.

Programmers

The most important shortcomings in programmed solutions to practical farm problems are with the programmers rather than the programming. Programmers must learn to apply programming to the right problems. Given that the problem is amenable to programming, the programmer must write down the restrictions properly. Given that he has the proper restrictions for the right problem, there remains the difficult job of interpretation and meaningful application of the results.

Applying programming methods to the right problems means (1) that the programming model corresponds reasonably to the real relationships of the problem and (2) that the problem is worthy of the attention of the limited research resources available to alternative research projects. The "right" kind of problem for linear programming analysis is defined according to the shortcomings listed above which originate in mathematics, statistics and economics. That is, programming is best suited to solving problems which do not involve imperfect substitution, imperfect competition and imperfect knowledge.

Given that the problem selected is amenable to programming, the programmer must be careful to write down the restrictions properly. When the model differs significantly from the facts, he must state the assumptions clearly and refer to them when interpreting the results.

The greatest difficulties in writing down restrictions are involved with (1) inputs used for more than one production period, (2) time dimensions, and (3) consideration of solutions which might be more satisfying to the farm operator than the profit maximizing one.

When inputs have more than one production period of useful life, it is necessary to carefully distinguish the stock of input existing at any point in time from the flow of productive services provided over the production period. Failure to distinguish the flow of services from its source has led to many serious shortcomings in programmed solutions to practical farm problems. Inasmuch as the theory of the firm is a flow model, all costs, returns and coefficients must be interpreted as flows of services or products per period.

We have become preoccupied with flows of services and of products which affect the flow of profits to the farm business. In so doing, we have neglected the stocks of assets which are reflected in the farmer's balance sheet. Adam Smith in his *Wealth of Nations* and Kenneth Boulding in his *A Reconstruction of Economics* are notable but rare examples of attention paid by economists to balance sheet information. Usually we leave these matters to accountants and to the business schools. If the farmer is unable to identify and to procure the stocks of resources associated with the profit maximizing solution, your analysis of his practical problem will be of little value to him.

The indivisibility of resources has been a source of concern to programmers. The problems of indivisibility would not have been quite so disconcerting, before the development of integer programming, had the programmer distinguished the discontinuous resource stock from the continuous flow of services emanating from that stock. Flows coming from discontinuous stocks are perfectly divisible and are explainable with continuous functions. Solving problems in the context of flow models only requires that the stocks from which the services flow are identifiable in order to make useful interpretations of the results.

Another shortcoming related to the analysis of durable resources is rooted in failure of the programmers to realistically determine which resources are to be considered fixed and which variable.[9] For example, April labor may be considered *a priori* to be fixed at 350 hours, and the programmer, after making this arbitrary assumption, considers it immutable regardless of opportunities for hiring more labor at $1.00 or $1.50 an hour should April labor prove a limiting resource in the programmed solution.

There is no reason why the programmer need consider any resource fixed *a priori*. He does need to know how much of each resource is owned by the operator, how much it costs to buy or hire more and how much that in the operator's possession can be sold for. With this information, and with activities for buying and selling stocks of resources as well as for utilizing their services, the best list of fixed assets will be determined endogenously by the program rather than exogenously by the programmer.

When capital restrictions are important in a farm problem, the distinction between stocks and flows helps to identify investments and expenses. Both investments and expenses can be explained by a single inequation in the model which tells us that the sum of all investments and expenses is less than or equal to the total supply of money.[10] This capital restriction adds realism and it is helpful in identifying balance sheet information associated with the programmed solution.

Other shortcomings in programmed solutions which originate in the programmer's failure to write down the "right" restrictions for useful

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[9] Clark Edwards, "Resource Fixity and Farm Organization," *J. Farm Econ.*, Nov. 1959, p. 747. See also Peter E. Hildebrand, *Farm Organization and Resource Fixity: Modification of the Linear Programming Model*, Agr. Econ. Dept. Pub. A. E. 769, Mich. State Univ., Nov. 10, 1959.

[10] See Model 2 in "Resource Fixity, Credit Availability and Agricultural Organization," unpub. thesis by Clark Edwards, Mich. State Univ., 1958. For an application see "A Linear Program Analysis of Grade A Dairy Farm Organization in the Oklahoma Metropolitan Milk Marketing Area," unpub. thesis by H. W. Grubb, Okla. State Univ., May 1960.

linear analysis have to do with time and utility. Ways to write down time restrictions in which we keep track of changes in quantities from one point in time to the next under the assumption of perfect knowledge are treated by Loftsgard and Heady.[11] Shortcomings stemming from failure to understand time as a factor of production which has a measurable productivity and an associated cost have received less attention. The role of time in batch production where more than one batch of a product may be produced in a single production period has been worked out in theory and applied to practical farm problems, yet ignored by linear programmers.[12]

Utility theory has long been understood by economists, and many agriculturalists have demonstrated that for some problems it is not mere profit maximization in the short run, but preferences for leisure rather than work, for Jerseys rather than Holsteins, for farming rather than a life in town, that have colored many farmer decisions. Verner Hurt has shown that these considerations are important in a linear programming analysis of Southeastern Oklahoma farms.[13]

Given that the programmer has the right restrictions for the right problem, there remains the difficult job of interpretation and meaningful application of the results. It is at this Achilles' heal that some of the most pointed barbs of programming's critics are aimed. In presenting their results, programmers should include information which would make it easy for each farmer to discover at the outset whether or not he is included in the class of farmers for whom the results are intended.

The benefits which farmers stand to gain in accepting the results of programming are not always worth the cost of obtaining them. Price mapping analysis has shown that several solutions usually exist which are almost as profitable as the "best" solution.[14] These "near" solutions may differ considerably with respect to farm organization, investment and demands on the farmer's ability. Write-ups should assess the merits of likely alternatives to the profit maximizing solution.

When the benefits of the programmed solutions are worth the cost of obtaining them, farmers sometimes find economic and/or technological

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[11] Wilfred Candler says, in "Reflections on 'Dynamic Programming Models,'" *J. Farm Econ.*, Nov. 1960, p. 920, that formally there is no difference between usual linear programming procedures and the Loftsgard and Heady model.

[12] W. B. Back, *Deciding When to Market Broilers*, Bull. 542, AES, Oregon State College, April 1954.

[13] V. G. Hurt, "Capital Investment and Resource Adjustments on Individual Farms in the Ouachita Highlands of Oklahoma," unpub. thesis, Okla. State Univ., May 1961, ch. 2.

[14] W. W. McPherson and J. E. Faris, "Price Mapping of Optimum Changes in Enterprises," *J. Farm Econ.*, Nov. 1958, p. 821. Also see Horace L. Puterbaugh, Earl W. Kehrberg and John O. Dunbar, "Analyzing the Solution of a Simplex Linear Programming Problem in Farm Organization," *J. Farm Econ.*, May 1957, p. 478.

barriers between their present situation and the optimal. The programmer owes it to his readers to assess the obstacles farmers are likely to encounter on their route toward the long-run optimum.

Finally, isn't it time someone undertook a serious study of farmer acceptance of programmed solutions to practical farm problems! What proportion of the group for whom the results were intended actually use those results? If the results were used, were they useful? That is, did the farmer who made the recommended changes fare better than those who did not?

Conclusion

In this paper, the shortcomings of programmed solutions to practical farm problems have been classified according to whether they originate in mathematics, statistics, economics or the programmer himself. The specific criticisms listed under each heading correspond to what a cross section of agricultural economists doing programming have expressed as the most serious shortcomings.

Making appropriate mathematical statements of real problems is limited by the computational methods provided by the mathematicians. Linear programming handles a subset of the class of problems of interest to economists in which we seek to maximize a criterion function subject to restrictions. Linearity is the price we have paid for the ability to handle larger problems and to incorporate inequalities and slack variables. Functional analysis offers non-linearity in the restrictions, but has other shortcomings. Non-linear programming will subsume both, but other important problems lie beyond the reach of meaningful mathematical statements of this kind.

Statistics has not been used to provide measures of significance of the results or to incorporate restrictions in the problem statement which represent elements of risk in the farmer's environment. Improvements are needed in using statistics to derive reliable input coefficients.

The shortcomings of linear programming which originate in the underlying economic theory have to do with the static nature of the theory used and with difficulties of aggregating micro-economic results into macro-economic relationships. Linear programming shares these shortcomings with other related methods of analysis.

The problems discussed above which originate in mathematics, statistics and economics are surmountable. The real problems, which may not be ameliorated in the near future, are with the programmers rather than inherent in the programming. Programmers must learn to apply programming to the right problems. Given that the problem is amenable to programming, the programmer must write down the restrictions properly.

Given that he has the proper restrictions for the right problem, there remains the difficult job of interpretation and meaningful application of the results.

DISCUSSION: CONTRIBUTIONS, SHORTCOMINGS AND POTENTIAL IMPROVEMENTS IN LINEAR PROGRAMMING SOLUTIONS

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There is some tendency in our profession to classify the members according to specific methodologies. Thus, reference is frequently made to budgeters, programmers, function fitters, and so on, rather than to agricultural economists. There is some basis in fact for the evolution of this system of classification, for as one becomes proficient in one approach, he tends to seek out those problems to which it can be applied. The result is that the method sometimes dominates the selection of problems to be analyzed rather than the problem dominating the choice of method. I fear that to some degree the literature on linear programming applications bears the scars of this situation.

The preceding papers represent an attempt to clear away some of the smoke that has surrounded discussions of linear programming, particularly as it applies to the analysis of microlevel problems in agricultural economics and farm management. Further, the authors have been directed to consider linear programming in terms of its applicability to "the solution of practical farm problems." There is some question as to what "practical farm problems" should be interpreted to mean.

In discussing the contributions of linear programming, Dr. Swanson has interpreted "practical farm problems" as referring to the direct application of the technique to the planning of commercial farm operations. As evidence of the usefulness of linear programming in arriving at "solutions to practical farm problems," he cites the use made of it by at least one commercial farm management service, by some very large farming operations, and to some extent by the Extension Service for individual farm planning. However, the skill and expense required in making such direct applications of linear programming limit its use mainly to the larger farming operations. The contribution of linear programming in this area seems rather insignificant when compared with the contribution that budgeting techniques have made in this same area. In addition to other minor uses, the Extension Service also uses linear programming as a teaching device for stimulating group discussions. It is difficult to assess the

real impact of this use of linear programming. By far the most significant contribution of linear programming cited by Dr. Swanson is the changes that it has inspired in conventional planning and budgeting procedures.

One tends to conclude from Dr. Swanson's discussion that the contribution of linear programming to "the solution of practical farm problems" has been rather minor. However, Dr. Swanson has chosen to consider primarily the direct uses made of linear programming as a practical planning device for farm operators. He has emphasized the use of the technique rather than the results of its use. One should not expect a very wide direct application to farm planning of a method such as linear programming. While the mechanics of solving a linear programming problem are not especially involved, its proper application requires a greater understanding of it than simply how to solve the mathematical problem. Persons who have the training in mathematics and economics necessary to use the technique to advantage are not likely to be found on many of our present-day farms. Furthermore, because of the magnitude of the computational task, the analysis of very complex problems will require the services of computers, which can be obtained but are costly. So far as farm management applications are concerned, the major contribution of linear programming, if one is to be made, will most likely be found in its use as an analytical device in the research programs of public institutions concerned with the problems of agriculture. Dr. Swanson noted this area of contribution in his opening remarks but excluded it from his discussion because of a narrow interpretation of the phrase "solutions to practical farm problems."

The contribution to the solution of practical farm problems of linear programming as an analytical device in the research process must be assessed in terms of the uses made and the benefits derived from the results. This is a difficult task. The development of linear programming has made it possible for researchers to analyze problems in greater detail and more systematically than was possible formerly. In effect, linear programming is substituted for clerical and professional labor in carrying out those phases of an analysis that can be reduced to a routine. This advantage is sometimes overshadowed by the inadequacy of the data used and the incompleteness of the models that are formulated. Also, the availability of linear programming has permitted agricultural economists to undertake projects which were previously considered to be out of the question because of the size of the task. One example is the study in interregional competition emphasizing individual farm adjustments. Such contributions are not insignificant and are directed toward seeking "solutions to practical farm problems."

In discussing the shortcomings of the results of microanalysis using

linear programming, Dr. Edwards has extended his discussion considerably beyond a consideration of the shortcomings strictly inherent in linear programming itself. It is more critique of the shortcomings of results of microlevel studies in agricultural economics in general than of linear programming per se. His conclusion is that many of the most serious shortcomings in the results obtained from past applications of linear programming were not inherent in the technique itself but in more basic areas of knowledge and in the inadequacy with which the linear programming models used were formulated. Many of these shortcomings can be eliminated without any substantial change in the technique itself. This would be done by exercising greater care in selection of data, in defining the relationships that apply to particular problems, and in expressing them in terms of the mathematical format of linear programming. Even the linearity assumptions that Dr. Edwards finds to be a serious problem need not be particularly limiting. To overcome this limitation requires the inclusion of additional equations and variables in the mathematical system. However, this often results in expanding the model to a point at which the cost of solving the problem becomes prohibitive. The development of alternative mathematical formats and associated solution procedures, which would provide for handling nonlinear relationships with greater facility than is currently possible, is certainly to be desired.

Of the shortcomings inherent in the linear programming approach cited by Dr. Edwards, I would consider the implicit exactness in the quantitative statements of the restrictions to be most serious. Techniques of incorporating estimates of the statistical reliability of the data into the linear programming procedures have not been sufficiently well developed as yet to be very useful in practical application. Furthermore, variance estimates are not readily available for many of the input-output data required in a linear programming analysis. The situation could be considerably improved, however, if research resources were directed to that purpose.

In the absence of development of theoretical concepts for more adequate handling of problems involving dynamics and risk and uncertainty, most of the improvements in linear programming will involve refinements to handle such things as discontinuities and nonlinear relationships with less cost and effort. The development of integer programming represents such a refinement. Indeed, until the necessary theoretical developments are achieved, it is impossible to say exactly what modifications are required in the mathematical format and solution procedure of linear programming to overcome its present shortcomings in these respects. It is likely that the methodology required will not closely resemble linear programming.

Basically, linear programming is nothing more nor less than a method for solving a particular type of mathematical problem. Many of the shortcomings of past applications of linear programming appear to stem from an inadequate understanding on the part of the analyst of how to utilize this device most effectively as an aid in analysis of an applied problem. This is the main point underlying Dr. Dantzig's remarks. Further, the present state of knowledge in basic areas is often such that we are unable to specify fully the relationships that operate. Thus we cannot expect to apply the results obtained directly without interpretation and qualification. Mathematical techniques of analysis such as linear programming are simply aids the analyst may use; they are not a substitute for the analyst.

DISCUSSION: LINEAR PROGRAMMING APPROACH TO THE SOLUTION OF PRACTICAL PROBLEMS IN FARM MANAGEMENT AND MICRO-AGRICULTURAL ECONOMICS

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Mr. Dantzig invented linear programming about ten years ago. I was fortunate enough to see Dantzig frequently while he was in the process of invention. It seemed to me then—and still seems to me now—that programming is the basic problem of economic life. Now, after ten years, it is appropriate to ask what results have been obtained. Obviously one result has been a lot of mathematical literature. But programming was intended as a means of solving practical economic problems—such as increasing someone's income, or reducing his costs. How are we doing along these lines?

Mr. Swanson finds that a few farms have been programmed—especially by Doane's Service and by North Carolina State College. This, as he says, is "a modest, but significant, beginning in its commercial application to individual farms."

He also indicates that formal programming methods have led to various improvements in "budgeting" farms. I am especially interested in his discussion of Weinschenk's method of starting with "the existing form of organization," then making profitable adjustments. This general procedure has merit, I believe, in a wide variety of programming. It is usually not necessary to use the elaborate simplex technique to find a solution that is "feasible," in a technical sense. The present organization of a farm, or the present feed mix, is known to be feasible. The only problem is to find improvements, if there are any.

Mr. Swanson's review shows that linear programming has not yet solved all practical problems of farm management. This is not surprising. We should stop looking for mathematical panaceas. A good econometrician will use a variety of methods; for example, least-squares regressions, factor analysis, canonical correlation, structural equations, and the theory of games.

Mr. Edwards has given us several reasons why the practical results of linear programming have been rather limited. He classified the shortcomings into four categories, according to whether they originated in mathematics, in statistics, in economics, or in the programmer himself. This is an excellent classification. Edwards is right that there are shortcomings in all four categories.

I do not think that the mathematical difficulties are the most serious. It is true that the usual mathematical techniques are limited mainly to problems that are linear and continuous. These techniques are adequate to handle some simple problems: transportation, contract awards, and mixed feed, for example.

But non-linear and integral solutions can be obtained by simple graphics, by the old-fashioned arithmetic called "alligation," or by the refined mathematics being developed by Dantzig and many others.

I suspect that our most difficult problems are with statistics and with economic theory. No program is more accurate than the input-output data on which it is based. Even in a simple problem, such as mixed feeds, we need much more accurate estimates of the effects of changes in various chemicals and vitamins.

Mr. Edwards rightly calls our attention to the need for dynamic economic theory—and for dynamic programming.

The basic problems of economic life may be programming: but many of them are non-linear, non-continuous, and dynamic. Certainly this is true of the complicated problem of running a farm. Even the simplest linear-programming techniques can be helpful, if used with discretion and judgment. And we can rely on Dantzig, and others of the mathematical fraternity, to develop more refinements. In time, some simple operations, such as mixing feeds for dairy cows, may become entirely mechanized. A machine could figure today's least-cost dairy feed, and probably mix it for you. But I doubt if we should ever be satisfied to let the electronic computer run our farms.

INTERRELATIONS OF FOOD MARKETING AND FARMING IN THE AMERICAN ECONOMY*

CHAIRMAN: GEORGE L. MEHREN, UNIVERSITY OF CALIFORNIA, BERKELEY

ECONOMIC INTERDEPENDENCE OF MARKETING AND PRODUCING FIRMS IN AMERICAN AGRICULTURE**

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TO ATTRIBUTE historical adjustments in any one segment of the American food industry unilaterally to any other segment is gross oversimplification. In recent years, much has been said of the changes in market "structure" of the food retailing industries. Too often the inference has been drawn that needed and actual adjustments at the farm level in American agriculture stem primarily from the upheaval in food merchandising methods. With some types of commodities and in some geographic locations farm production techniques, enterprise organization, and business control have responded drastically to changes in markets. Yet, for the vast majority of American farms and ranches, management is motivated to increase size, to mechanize, or to reduce risk and uncertainty, not because of changes in market "structure," but by profit opportunities associated with internal reorganization and resource acquisition.

These profit opportunities stem from technological innovations in plant and animal breeding, mechanization, disease and pest control, fertilization, and irrigation, as well as from changing input supplies—most notably in the case of labor. The vast technologically-induced changes on the farms and ranches supplying the raw materials for our food and fiber have necessitated extensive adjustments in processing and marketing. Thus, adjustments in the various segments of the food and fiber production and marketing sequence may stem from changes in either or both the "supply" (farm and ranch production) and "demand" (retail distribution) sectors.

The purposes of this paper are: (1) to identify the major forces in the food production, processing, and selling sequence that have fostered adjustments by component firms, (2) to outline the nature of the impact of selected forces on the economic structure and operation of farms, (3) to indicate the impact of selected on-farm adjustments on processing and dis-

* Joint Session with the American Marketing Association. Mr. Wroe Alderson, University of Pennsylvania, also participated as Discussant, but did not prepare comments for publication.

** Giannini Foundation Paper No. 205.

tribution, and (4) to examine the attributes of production and marketing of selected agricultural commodities in the United States to illustrate the type of adjustments that have come about.

Retail food market structures

In recent years the literature concerning market structure in food industries has been augmented substantially.[1] Limited inquiry has been made into the effects of changes in markets on the agricultural producer.[2] Analyses of the impact of shifts in agricultural production technology on processing and marketing are conspicuously absent.

At the distributor (integrated retailer) level, the growth in direct buying as a result of increasing absolute size of retail firms and improved transportation, the reduced number of buyers in many markets, and the expansion of product specification as a means of exercising effective control over the products purchased are of major importance. The effects of these changes are transmitted to the various suppliers, including processors and farmers, in the form of increased bargaining power to be faced, greater emphasis on product specification, more advance contracting, an increase in private branding, and by other more subtle means.

Food market structures at initial levels

Market structure and conduct at the initial market levels differ markedly from those closer to consumers. Nor is the pattern of adjustment in these markets explainable only by developments at the retail level.

Markets in which farmers sell vary in structure from almost purely competitive to near monopoly in isolated cases, depending on product and location. Typically, however, the farmer is faced with an oligopsony with a nearly-competitive fringe. Mergers, individual firm growth, and affiliation of independent firms to achieve the advantages of large scale buying have increased the oligopsonistic character of the food retail markets. Horizontal integration at the retail level has fostered brand

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[1] See for example: Davis, John H., "Vertical Integration of Production and Marketing Functions in Agriculture," *Policy for Commercial Agriculture, Its Relation to Economic Growth and Stability,* U.S. Congress, Joint Economic Committee, 85th Cong., 1st sess., Nov. 22, 1957; DeLoach, D. B., *Changes in Food Retailing,* Wash. Agr. Expt. Sta. Bul. 619, Oct. 1960; Mehren, George L., "Marketing Coordination and Buyer's Requirements," U.S. Congress, Joint Economic Committee, *op. cit.;* Mueller, Willard F. and Leon Garoian, "Changes in the Market Structure of Grocery Retailing 1940-58," Res. Rept. 5, Wis. Agr. Expt. Sta., April 1960; Southworth, Herman M., "Increasing Efficiency in Marketing Agricultural Commodities," U.S. Congress, Joint Economic Committee, *op. cit.;* U.S. Dept. of Agriculture, Agricultural Marketing Service, "Changing Marketing Channels for Farm Foods," Oct. 1959; U.S. Dept. of Commerce, Federal Trade Commission, "Economic Inquiry into Food Marketing, Part I, Concentration and Integration in Retailing," Jan. 1960.

[2] See, for example, Collins, Norman R., and John A. Jamison, "Mass Merchandising and the Agricultural Producer," *J. of Marketing,* Vol. 22:357-66, April 1958.

development and acceptance, generating occasional profitable ventures in grocery manufacturing, extensive contracting for items packed to specification under private brands and increased direct purchases from producers.

Alternative analytical approaches to research into the price and nonprice aspects of imperfect competition in agricultural markets have been well presented and illustrated by Clodius.[3] His presentation of the role of economic theory in explaining the motives of management and observed results is particularly appropriate.

Producers, through cooperative ventures, have generated some degree of market power with given products in some localities. Cooperative bargaining associations and cooperative processing and marketing firms have increased in importance. Cooperative organizations formed to market such products as lemons, oranges, avocados, and walnuts have been able to approach a monopoly position, practicing market discrimination techniques, withholding from market or disposing of the product to exploit the demand function in the interest of increasing total return to producers, and exercising other devices available only to those in near-monopoly positions. The bargaining strength of the cooperative is determined by the degree of control over supply, the cross-elasticity of demand with competing products, the barriers to entry, buyer concentration and knowledge, to name the most important. In other instances producers have, through cooperative action, invaded the processing industries to compete effectively as members of oligopolistic (fruit and vegetable canning) or, at least, monopolistically competitive (wine) agricultural industries. Increased buying power by retailers and selling power by producers have, in some product lines, reduced margins to processors substantially.

Firm Interaction—Causes, Effects, and Adjustments

Examination of given agricultural industries provides some basis for evaluating the impact of selected market forces on individual farms and, conversely, of adopted production technology on processing and marketing firms. However, considerable caution must be exercised in identifying cause and effect. Changes in market structure, particularly at initial levels, have increased producer interest in markets and marketing decisions. This is not to imply that attention has shifted from questions of production efficiency but that the managerial input in agriculture has necessarily been expanding in perspective.

Similarly, adoption of new technology in production is often accompanied by changes in processing techniques and markets. While it is prob-

[3] Clodius, Robert L., "Developing Buying Policies in Decentralized Assembly Markets," *J. Farm Econ.*, 40:1541-50, Dec. 1958.

able that changes in distributors' procurement practices have encouraged the development and adoption of improved varieties and practices, the major motivating force has undoubtedly been the opportunity to increase net earnings through cost reduction per unit of output by the adoption of new production technology.

An examination of production and marketing of five different types of agricultural commodities illustrates the nature of adjustments taking place at various points in the sequence with a variety of products in many locations.

Perishable commodities for fresh consumption—lettuce and shipping peaches

The producers of a highly perishable commodity such as lettuce have been particularly vulnerable to concentration in buying. For example, in the Salinas-Watsonville (California) summer lettuce district, at one time, fifty buyers constituted the market. It is contended that today less than a dozen buyers are purchasing for organizations which control an estimated 75 percent of the lettuce sales at retail.[4] It is argued (and economic theory supports the argument) that receivers, having power to reject on the basis that the product was in unsuitable condition at the time of shipping, can shift the full impact of excess quantities in the market onto the producers while maintaining relatively stable retail prices.

Individual growers have attempted to increase their bargaining position by packing their own lettuce and that of other growers. Much effort has gone into establishing volume and brand names in an attempt to attract and hold larger buyers. Quality of product and timing of plantings to insure sufficient and continuing volume have received special attention. Some success has been achieved by the larger-volume grower-shippers. However, part of their success has been at the expense of the smaller producers who have contracts to supply the grower-shipper with part of his needs. Thus, the large grower-shipper has some opportunity to sell his own product in the high price periods and sell that of his contracted producer on days when prices are less favorable. With additional price risk shifted onto him, the small-volume producer finds it increasingly difficult to survive as the price risk he must bear increases. Producer willingness to cut and ship as long as price meets or exceeds marginal costs of harvest has undoubtedly been exploited by buyers.

Two trends seem apparent. In the short run, marketing orders aimed at stabilizing the flow of summer lettuce to market might permit all pro-

[4] Testimony of Mr. Ralph A. Nemanick before Subcommittee No. 5 of the House Select Committee on Small Business to conduct a study and investigation of the problems of small business, Nov. 10, 1959, San Francisco, Calif., Small Business Problems in Food Distribution, Part II, Vol. 2.

ducers to stabilize and perhaps increase net incomes. In the longer-run period, large volume grower-shippers will get larger and eventually, in all probability, force buyers to enter into formal or informal agreements. Those firms remaining will be large-volume concerns producing and packing. Closer coordination between retail demands and production can be achieved. Conventional price-making forces identified with the impersonal centralized market will largely have given way to bilateral bargaining. Where forward sales are arranged, price limits will approximate those appropriate to the bilateral monopoly model.

At the production level, field packing of lettuce in fiberboard containers and vacuum cooling are technological developments fostering adjustments at various stages of the marketing sequence. Adjustments to new production technology often involve processors in furnishing machines or labor. In lettuce, packing sheds and icing of wooden crates prior to shipment have practically disappeared. Additional motive power per train of lettuce cars is required to run the fans in the newer type of cars. Women clerks at the retail level can handle the lighter, cleaner package. Bulk-bin harvest, vacuum cooling, and rapid transit in bins to distribution centers appears to be the next step. Further packing will be designed to meet the specific needs of local retail outlets.

The producer of shipping peaches has three alternative strategies he can follow. First, he can expand into packing and cold storage if he produces sufficient volume and seasonal spread in varieties, or can contract with other producers. A broader managerial skill is required to coordinate the production and marketing aspects of the business. A new type of labor is required, often introducing the basis for substantial reorganization of the entire operation around a more permanent, higher-skilled labor force. Such reorganization is in keeping with acceptable solutions of the current labor problems in this type of agriculture. Total capital requirements—both fixed and working—for the farm increase.

But his bargaining power is not likely to equal that of the buyer representing an integrated corporate chain or a group of affiliated independents. The incentive to achieve sufficient volume to supply the total needs of one or more large-volume buyers in order to exert greater bargaining power is tempered by the fact that economies of large-volume operations in fruit packing are associated primarily with spreading of fixed costs over larger total volumes since the total variable cost function appears to be linear.[5] Advantages of increased size are largely exhausted at volumes far below most buyers' total demands.

As second and third alternatives, the smaller-volume producer can ar-

[5] French, B. C., L. L. Sammet and R. G. Bressler, "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears," *Hilgardia*, Vol. 24, No. 19, July 1956, Univ. of Calif., Berkeley.

range to market through a grower-shipper or join with other producers in a cooperative packing and marketing venture. Much historic precedent exists for the latter course of action. Cost reduction through volume packing is subject to the same economic forces regardless of form of business organization. Further, where the private firm can expand by merely adding capital, the cooperative organization may have to consider questions of equity among members, particularly when capital for expansion is obtained from the membership. How well an individual member fares will be determined in large measure by the astuteness of the management of the cooperative.

The member of a cooperative fruit marketing organization using long-time pools may share intraseasonal price risks with other producers, thus reducing the impact of a very low price at the time he would ordinarily market. With some products cooperative association members have become aware of the need for understanding intertemporal demand relationships as a basis for intraseasonal price discrimination.

Perishable commodity for processing—tomatoes

Producers of fruits and vegetables for processing face an oligopsonistic structure of canners and freezers who contract most of their tonnage, Contracts between tomato producers and processors typically specify acreage, minimum quality, rate of acceptance and price. Growers who have become dissatisfied with their lack of bargaining power have in some areas formed bargaining associations. Many producers have failed to recognize the pressures placed on processors by the increased concentration at the retail level. Profit rates in processing are already relatively low. Large retailers have forced price and other concessions from processors either directly through bargaining or by entering into direct competition. Independent processors have attempted to force producers to share in whatever concessions are made.

The grower-owned and operated cooperative processing facility represents a formidable element in the fruit and vegetable processing industry in California and elsewhere. The individual producer-member increases his profit (and loss) opportunity in exchange for the use of some of his capital, perhaps some of his managerial talents, and some of his rights as an individual producer for a specified period. Insofar as processing creates additional services for which housewives are willing to pay, the cooperative processing member stands to gain since the demand for services is rising at a much more rapid rate than the demand for the physical product.

The impact of a change in production technology on processors is well illustrated by the pending mechanization of the tomato harvest. Nearly full adoption within two years of perfection is virtually assured in the face

of a 40 percent reduction in picking costs and a shortage of seasonal field labor. To the processor, internal damage to the fruit and concentrated arrival at the plant are critical factors. Serious off-flavoring in products resulting from enzyme action in damaged areas can be overcome by shortening the elapsed time between the field and processing. Handling the total production in 30 to 40 days is less easily solved. Processors will adapt to quality decline by increasing tolerance in grade and reducing the time lag. What action will be taken to meet the peak in delivery is not known. Producers may be faced with contracts specifying delivery dates to insure a longer processing season. Processor adaptation may involve reduced contract prices to producers.

Livestock product paritally integrated—beef cattle

Major changes in beef cattle markets from the producer's point of view have been the increase in direct buying on specification by retailers from packers, the relocation of packers in the "interior" and the concurrent decline in terminal market volume. Specifications buying by retailers, together with their entry into meat packing, has induced the packers to pay more for animals meeting the specifications. The move of packers to the country has been advantageous to producers in reducing marketing costs. But the concurrent decline in terminal market volume and the decline in average quality of animals moving through the terminal market have partially destroyed the major pricing point for livestock. Volume buyers operating in the country have apparently been able to force sales concessions that could not have been accomplished in the terminal markets.[6]

The feedlot operator has found it advisable to increase his volume and to feed in exact conformity with quality and weight specifications. Failure to do so means loss of outlet or lower price. The margins today's commercial feeders experience will not permit them to stay in business indefinitely at prices packers are willing to pay for animals not meeting their specifications or those imposed by the retail buyer.

The farm feeder finds it increasingly difficult to market his small lots in competition with the larger-volume feeder. He is often limited to an auction sale or must incur disproportionately high shipping expenses and shrink to market. The option to feed for others on contract is ordinarily not available to the farm feeder. Thus, the small-volume farm feeder faces a declining return on his labor, his farm-produced feed and his investment in agriculture. Many farm feeders have been forced to abandon feeding and sell feed. A few large feeders in any region can influence the

[6] Testimony of Louis F. Bein, Berthoud, Colo., before Subcommittee No. 5 of the House Select Committee on Small Business, Nov. 16 and 17, 1959, Denver, Colo.

prices the producer receives for his feed within limits imposed by interregional transfer costs. These influences combine to reduce gross farm incomes, on-farm employment for the farm labor force, and operator earnings.

Where packers do their own feeding or where close ties exist between packers, feeders, and retailers, the independent feeders may share disproportionately in the losses during low price periods and in the gains during favorable price periods. During periods when the supply of fed animals exceeds the demand of packers at prevailing prices, many feeders must resort to consignment selling. Under such circumstances packers, acting as brokers, have been accused of using this meat to undersell other wholesalers.

The range livestock producer increasingly is selling to order buyers representing feeders. To meet packers' specifications and still make money, the feedlot operator desires to purchase animals that he can bring to appropriate weight and finish at minimum cost to him. The feeder seeks healthy, light weight animals in thin condition. But the range cattle producer has looked to a heavy calf at weaning time, a high percent calf crop and a good quality calf for his profit. He has accomplished this with big cows, early breeding to quality bulls and close attention to the nutritional requirements of his cow herd. If the rancher is forced to provide lighter animals to the feeders, either the feeder will have to pay more for them or the rancher will be forced to shift his breeding, feeding and/or marketing program in an attempt to meet the demands of the market. The latter alternative cannot be accomplished without severe readjustments in range resource use and pricing of inputs.

Livestock product totally integrated—broiler production

It is estimated that approximately 90 percent of all broilers produced in the United States today are grown under contract either with a feed company or a processing firm. The corporate grocery chains and other retail organizations purchase the bulk of their supplies direct from the processors who have placed large plants in the areas of concentrated production.

Feed companies are the principal contracting firms supplying chicks, feed, credit, management, risk-bearing, and marketing services. Typically, title to the birds remains with the feed dealer. The "producer" may, under some types of contracts, receive added inducement over his salary for "outstanding performance." In this most complete of all types of contracted production the producer is little more than a salaried employee with extremely limited opportunity to exercise his managerial skills.

The pattern of development of production and market organization in the broiler industry provides much grist for those who wish to speculate

on the future of other types of livestock feeding operations. Similar contractual arrangements for the production of hogs are available with feed companies but there is varied opinion as to what extent this will expand. A primary deterrent appears to be the fact that the two principal ingredients—corn and feeder pigs—are produced on the same farm. The labor supply is readily available and financing is associated with feed production rather than feed purchases. Also, feeder pigs are not easily produced in quantity as are chicks. Physical and biological considerations in many types of agricultural production are likely to continue to overshadow market influences in directing organization and structure at the farm and initial market levels.

Perishable commodity with controlled price—Los Angeles fluid milk market

Production and marketing of fluid milk for the Los Angeles area provides examples of many types of interactions which affect all segments of the industry.[7] Further, influence of institutional constraints as modifying factors in adjustment by individual firms and industry segments is clearly illustrated.

The distributive trade, to which the producers sell, can be characterized as an oligopsony with a fringe of many small firms on the buying side and an oligopoly with a fringe on the selling side. Difficulty of transfer from one distributor to another creates a near monopsony facing the individual producer. Minimum producer and resale prices are established and trade practices are stringently controlled under State legislative authority. Entry of new distributive firms in the face of excessive industry capacity takes place with the major objective of all firms being maximization of Class 1 sales.

Ties between distributors, retailers, and producers are of several forms. Since competition among distributors centers on increasing their sales, several techniques have evolved to capture shelf space in retail stores. Some large distributors have invested in established supermarkets to acquire exclusive supply rights. Four supermarkets have established or purchased stock in "captive creameries" primarily to avail themselves of volume delivery and the profit opportunities available as a result of the minimum resale price provisions.

Dairymen are directly affected by the struggle for market shares. Whenever one distributor loses or gains outlets, his suppliers either lose or gain in volume because of the producer-distributor contract system. The buy-

[7] For an economic analysis of the Los Angeles milk market see Fletcher, L. B., "Growth and Adjustment of the Los Angeles Milkshed: A Study in the Economics of Location," unpub. Ph.D. thesis, Univ. of Calif., 1960.

ers' market which, to many, appears to be nearly chronic in nature has produced a contractual system favoring the distributor.

The pricing and contract system for fluid milk prevailing in California has resulted in a revenue structure facing the producer unique in agricultural markets. The average revenue function is infinitely elastic at the Class 1 price level in the vicinity of the level of output equal to the Class 1 guarantee. Lower levels of production result in cancellation of contract. As production and sales increase beyond the Class 1 guarantee, the average revenue declines, the slope being determined by the rate at which lower class uses substitute for Class 1 usage. The marginal revenue function is thus discontinuous and, depending on how fast average revenue falls as output is increased beyond the Class 1 guarantee, optimum output for the individual dairyman may be constant over a fairly wide range in marginal unit cost.[8]

About 70 percent of the market milk fat in the Los Angeles milkshed is obtained directly from local producers. Approximately 20 percent represents bulk transfers from the San Joaquin Valley. The remainder comes from other less important areas. Contractual terms vary widely between the two major supply areas with much more favorable contract terms being offered to the producers adjacent to the consuming area. Since there is no price incentive to the distributor which would encourage this procurement pattern, it rests largely on historical precedent and the opportunity to maintain tighter control over the shippers.

The production costs per hundredweight of milk (including transportation) in the metropolitan area are considerably higher than in the San Joaquin Valley. The producer in the metropolitan area maximizes his profits by merely meeting the production as required in his contract. If he wishes to expand his sales, he can do so profitably only by purchasing additional "shipping rights" currently at the rate of approximately $400 per pound of fat per day. The willingness of producers to pay such prices is an indication of the interaction of the pricing and contract system.

By contrast, the San Joaquin Valley producer enjoys lower production costs on the average but also faces a lower blend price for his product. He tends to produce beyond his base quantity, selling a relatively large proportion of his output for lower prices. He constantly strives to increase both his base and "Class 1 guarantee" as a means of raising his net income.

Recently, producers in the San Joaquin Valley attempted to exert collective power against the distributors to achieve more equitable treat-

[8] For a discussion of optimum adjustments on individual dairy farms in the Los Angeles milkshed, see Davidson, J. R., "Economic Efficiency and Firm Adjustment for Market Milk Products in the Southern Metropolitan Milkshed of California," unpub. Ph.D. thesis, Univ. of Calif., 1960.

ment relative to the producers in the Los Angeles area. The result of this ill-timed venture clearly demonstrated that the bargaining power resides with the distributors and that the elasticity of supply response in the metropolitan producing area currently approaches infinity within relevant levels of output.[9]

A Look to the Future

Increased exertion of buying power by various elements in the food industries is anticipated. The growth of corporate chains and voluntary and cooperative purchasing groups continues. Many of these organizations have failed to exercise the degree of market power of which they are capable. Fear of anti-trust action and, in some cases, concern over public opinion have been partly responsible.

Initially, major impact will fall on those lines of production such as fresh fruits and vegetables and livestock which have already experienced extensive market reorganization and adjustment. Cotton producers may well face increasingly stringent specifications as competitive fibers are continuously improved. Other commodity groups in given localities yet "untouched" will certainly feel the pressures of market reorganization, but the conclusion that all agricultural producers, regardless of location or commodity, will succumb to the pressures of organizations in the market is not justified.

Farmers' and ranchers' bargaining positions in many areas and in selected commodity lines have tended to become relatively weaker in recent years with several notable exceptions, which include some processed vegetable and fruit crops, nuts and other products. Collective action by producers in some limited lines of production and in some areas has provided various degrees of market power. Bilateral bargaining will undoubtedly become more prevalent in setting pricing and terms of trade between various elements in the production-marketing sequence. But even under conditions where producers are able to engage in collective bargaining with various buying organizations, increasing market-induced influences will be exerted on resource allocation, scale of operations, scope of managerial decision making, and capital structure on American farms. Technological innovations will continue to influence strongly individual farm and ranch adjustments and will undoubtedly foster further changes in processing and marketing.

In the past there has been a tendency to view all market-induced changes at the production level as injurious to the individual producers. In the period ahead this view must be modified if producers and pro-

[9] Fortunately for the northern producers, lack of facilities for handling fluid milk beyond day-to-day needs in the Los Angeles area together with the fluctuations in consumption prevented distributors from completely severing all contracts.

ducer groups are to reap the gains which can accrue to the participants in a well organized and coordinated production-marketing system. For example, many broiler producers are now enjoying a higher income with less uncertainty than they had previously known. Many produce growers and shippers have been able to diversify and reduce in part the wide fluctuations in net income.

The greatest benefits from changes in food market structure have undoubtedly accrued to American consumers in the form of lower prices, better quality merchandise and greater convenience. But, as competition in food production, processing, and marketing continues to squeeze profit margins, the tendency toward tacit agreements among competing firms at various levels in the marketing sequence will increase. Public agencies responsible for policing business practices may find appropriate criteria for measuring illegality increasingly difficult to establish. What constitutes an unfair practice, or excessive concentration of power, under one market system may be necessary to the survival of critical elements in another. The strategies of firms at all levels must be subjected to continuous scrutiny against a constantly shifting industry structure. It is conceivable that producer cooperative organizations will lose some of their past immunity from regulations imposed on other types of business organizations.

REQUIREMENTS OF CONSUMERS, DISTRIBUTORS, AND PROCESSORS THAT ARE IMPORTANT TO FARMERS

Henry B. Arthur
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IT CAN BE accepted as almost axiomatic in today's economic arrangements that the economic reason for existence of the various productive activities of our country lies basically in the consumer demands at the end of the production and marketing chain. Economists are on a common footing with retailers, wholesalers, marketers of all kinds, and indeed producers, in affirming that our economy to be effective must be consumer oriented. How do we become consumer oriented? It seems to me clear that this is accomplished first by determining the nature of consumer demand and secondly by developing an effective integration of all the elements necessary to mobilize the productive resources that are required for satisfying those demands.

The farmer is not only concerned with the many dimensions of consumer demand. He must react also to the added factors that are injected into this total demand by the requirements of the retailer, the wholesaler, the processor, or even the requirements of the transportation system. His product must appear attractive in a retail store. It must lend itself to certain kinds of packaging requirements, it must hold up under varying temperature and humidity conditions and it must be able to withstand abusive handling in transportation.

All of these are well-known considerations. However, the farmer cannot afford to overlook the fact that each of the agencies who share with him the responsibilities for serving consumers are going to exert their own preferences and assert their own requirements in order that they may present to the consumer the kinds of products he wants.

The important point is that this is a joint enterprise in which the farmer is a partner with those who add their services to his product. The partnership has a single purpose which is seldom asserted and often unrealilized—the purpose of meeting consumer demands and preferences in the most effective and efficient way.

Another way of stating this general proposition is that we live in a business system where demands are expressed both in price offers and in preferences.

Economists have called ours a "market" economy, or a "free market" economy. The word market cannot be taken even by the theoretical economists as representing a place in which all transactions and all relationships take the form of simple spot buying and selling on a cash basis. It is not a market of price bids and offers as depicted on a supply or demand curve. Instead, the markets with which we are concerned

are complex affairs which involve a good many variables and which provide a vital service in integrating a very complicated set of tasks ranging from initial tilling of the soil to the final checkout at the retail cash register. Some of these services don't appear to take the form of a market transaction at all. They may consist of an advertising communication. They may result from a decision with respect to inventory holdings. They may have been vastly influenced by the selection of a brand name or the publication of a new recipe. Betty Crocker may be serving you well even though you don't know how much you are paying for her services.

The Multidimensional Aspects of Demand

It may be worthwhile at this point to wrap up some of the major characteristics or attributes of demand for farm products including those already discussed. Each of these should be searched diligently by the farmer and by all of those joined with him in the food industries in order to discover opportunities to do a better job of serving consumers and of winning their preferences.

1. The physical demand for food, as a basic living requirement, is primarily related to population. It is not easy to dispose of huge surpluses even by giving them away. The way to cure the surplus problem is not to produce a surplus in the first place.

2. While demand does respond to stimulation, this response is very likely to open opportunities for more services rather than for more tonnage. However, demand stimulation may also serve to shift preferences from one farm product to another.

3. Changing styles or fads have been important elements in demand shifts over intermediate periods, running from several years to a decade or more. For instance: drinking of milk; vitamins and the fruit and vegetable emphasis; consciousness of protein qualities; avoidance of saturated fats, or all fats for that matter; interest in pizza pies, etc.; and most recently a wave of emphasis upon metered calory diets even if a meal is replaced with a synthetic concoction in a tumbler.

4. Habits, customs, and so forth have long been recognized as important demand factors in certain markets. Examples are too numerous to list, but include fish on Fridays; non-pork items for Kosher areas; turkeys at Thanksgiving, hams at Easter (even baby lambs for Greek and Armenian Easter); bock beer in the spring. Coffee breaks probably come into this category of permanent institutions. Why did coffee breaks focus on coffee?

5. In previous generations demand tended to accommodate itself to seasonal availability (or unavailability). This has tended to break down with changing technology, but there may still be opportunities in this area.

6. Now comes an anomaly. Demand is dependable and stable; yet retail prices of many foods are highly volatile, particularly in the short run.

7. As a result, the average consumer is highly price conscious. Partly this is a result of the very volatility of prices themselves; partly I am convinced it is synthetic. It is aided and abetted by the prominent place occupied by price in competitive retail food advertising, backed by the fact that many so-called "specials" are indeed "specials," at 10% or 20% reductions. Such reductions are big items in the family budget. Generally the price is the thing that is "news" in the food ad. Real questions are raised by this peculiar pricing phenomenon. Often there is little economic reason why prices *have* to change from week to week. The price variation is a merchandising device. The retailer, who is in effect selling excitement invites the consumer's eye to the comparisons the dealer wishes to dramatize with little regard for anything so prosaic as matching supply and demand for individual items. The trade keeps "nudging" the consumer to shift his demand or preference from week to week, and apparently consumers love it. How about the farmer—should he love it or deplore it? Does it give him needed flexibility or is he helplessly penalized by a weak bargaining position?

8. One added characteristic of modern business must not be overlooked even in as old and well-established an industry as agriculture. This is the impact of dynamic changes in demand and changing technological requirements. The farmer is well aware of the changing technology which characterizes his own operation, but he is less likely to be impressed with the opportunity, indeed the necessity, of adjusting his own activities because of the technological changes that affect other parts of the economic structure he serves.

(At the risk of digressing a bit I think it is worthwhile saying that many governmental programs undertaken on behalf of agriculture have tended to protect the farmer from the need to adjust to changing conditions. The operation of a market economy has as one of its greatest virtues the effectiveness with which it reflects changing conditions, changing opportunities and changing prospects. Government programs too often become a haven for highcost, inefficient operations.)

How Well Do Farmers Respond?

Dynamic changes and adjustments are extremely meaningful to farmers, often accounting for success or failure. We must turn therefore to a consideration of whether or not under present day conditions our system actually does provide farmers with the information, incentives and helps they need as they adjust to such changes and opportunities.

By what means does the agribusiness system pull itself together so that the farmer can apply his efforts in the most fruitful way? The old

time answer would have been "through a series of competitive markets." Competition in the market place. Today this is hardly an adequate explanation. It doesn't cover all of the channels through which information and incentives flow up and down the line.

To begin with I have emphasized the consumer because it seems to me that this is the one bench mark, the one decision point, that is most nearly independent in the entire structure. This, as I understand it, is what people mean when they say "the consumer is king."

As we consider the marketing process in terms of the consumer reaching up the stream of distribution, processing and production to secure the materials and services necessary for satisfying his wants, we can trace the many variables we encounter with some sense of their purpose and with some basis for appraising their value. If we start from the consumer we have a better chance that our answers regarding other market variables will fall into a usable pattern.

The pattern could be illustrated in any number of agricultural product markets. It can be highlighted under three headings, each of which deserves more attention than it has received. (a) If the farmer is to play his part most effectively he must be supplied with three elements: (1) information; (2) incentives; and (3) access to resources. (b) The farmer is expected to react to changing demand which may stem from the consumer or from changes in technology or from changing business arrangements anywhere along the production or marketing chain. These are generally not arrangements for which the person to whom he sells his product in the first instance is solely responsible. (c) The many threads of relationship that tie the farmer to his ultimate market should have a single focus: the objective of making a total integrated marketing structure that is both effective and efficient, free from extraneous and wasteful elements on the one hand and alert to opportunities for improvement on the other. Efficient communication must exist throughout the entire structure, not just from one link to the next.

The importance of these characteristics of the interrelated agribusiness complex becomes most apparent when major changes occur in the existing arrangements. These changes may come as long-time trends or they may have the explosive impact of a cranberry scare. In either event they bring to light information which is helpful in appraisal of our problem.

The Revolution in the Food Industry

The food industry has never before experienced such an explosive revolution as has occurred in evey facet of the industry in the past two or three decades. Practically every change has called for a series of other major changes or adjustments up and down the line.

(1) Starting with the consumer, we have the continuing trend toward

up-grading of eating habits (in terms of variety, quality, convenience, nutritional adequacy, etc.). Not only are consumers eating better; their shopping habits are changing as more housewives hold jobs, as larger families require larger quantities of food, and changes in frequency of shopping. Other activities compete for meal-preparation time. Without exploring the cause and effect relationships, we find the great swing to suburbia, to retail facilities adapted for automobile shopping, for the handling of large and bulky purchases, for providing prepackaged self-service, and for many other changes that have surely had their impact all the way back to the farmer.

The dramatic contrast can be suggested by a few simple reminders from our grandparents' day. At that time the great innovation was the telephone which enabled a mother (probably tied down by young children) to phone her grocer and her meat market and secure delivery of the order to her kitchen on a daily basis. Produce and fish were frequently brought to her door by the huckster with his horse and wagon.

Cash has virtually replaced credit in consumer food buying; it used to be that the largest use of consumer credit was represented by the monthly grocery bill. Today the demand for food may be suffering considerably as a result of the pressures exerted by the need for family funds to pay this month's installments on the automobile, the TV set, or last summer's vacation. There are, in fact, a few innovations being undertaken in the form of rotating or drawing account credits by which banks take over the job of paying regular trade accounts on behalf of consumers.[1] This is still far too small a practice to justify any conclusions as to its possible significance for retailers, processors, or farmers, but it may conceivably become significant.

(2) The revolution in retailing is so apparent that it hardly needs mentioning. Mass distribution, self-service, and multiple store organizations have all but swept the small store and the unaffiliated retailer out of the picture. Numerically he represents a large number, but in terms of volume he has declined to 20%, or thereabouts, of the retail food store business.

Rather than describe mass retailers I want to point out just one or two less discussed aspects of the food distribution business which may be of importance to farmers. The first is the rapid and important growth of food retailing through hotels, restaurants, schools, in-plant feeding arrangements, school lunch rooms, etc. This is the ultimate in built-in maid service. At the same time it is an important channel of distribution about which we hear relatively little. The government in its surplus dis-

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[1] See Norman Townshend-Zellner, "The Bank-Charge-Account Plan and Retail Food Marketing," *Agr. Econ. Res.*, USDA, Oct. 1960.

posal programs has indeed tapped this channel to some extent by using schools and institutions as an outlet. The latest addition to the pattern is the vending machine—which takes the human touch out of selling altogether and transfers it to the buyer.

The second comment regarding retailing also goes beyond the retail counter. It has to do with the wholesale procurement activities of mass retailers. These large institutions, in contrast to small independent stores, have to delegate the buying responsibilities to specialists, to employees other than the top executive. Innumerable problems arise in this connection. The buyer seldom sees the particular goods for which he has contracted. Moreover, in order to plan ahead, he has to place orders and make future commitments on a large scale. All of these developments present important challenges to the producers and processors of food products.

The revolution in food retailing has been obvious to all of us; the revolution in wholesaling has been less conspicuous, but no less important in its consequences.

The food wholesaling business is in fact a new industry in recent years. Not only have corporate chains absorbed the wholesaling function, with their warehouses, distributing points, buying committees and the like, dealing direct with manufacturers, but the so-called old line wholesaler as he operated a generation ago has disappeared. Some of his number have metamorphosed into sponsors of voluntary groups of retailers with very close ties between supplier and customer that go far beyond a simple buying and selling relationship. Other wholesalers have been displaced by important retailer-owned cooperative wholesale establishments. Between chain store buying departments, voluntary group sponsors, and co-op wholesalers, the great bulk of the wholesale food business —probably 60 to 75 percent—has shifted away from old-line wholesaling as well as from selling direct to retail stores through manufacturer wholesale branches.

In face of such changes it is little wonder that processors, and farmers as well, have had to re-examine their channels of distribution and ways of doing business.

(3) The revolution in the food industry has not been confined to distribution. Processors have found it necessary to change their entire attitude toward their business. Self-service and prepackaging have meant that processors must have their eye on the consumer if their product is to gain preference. New techniques, new built-in maid services, new preservation methods such as freezing and dehydrating, all of these are changing the face of the food processing industry. More than a third of the home consumption of coffee is purchased as soluble or instant coffee. Similar changes have occurred in the freezing and concentrating of orange

juice, and may be in the early stages as respects dehydrated or otherwise prepared potatoes.

Inevitably the result of the changes that have been occurring all along the line is a demand for dependable quality, for uniformity, for the availablility of large single purchases. This carries all the way back to the farmer.

(4) Many other attributes of the revolution in the food industry could be mentioned, such as transportation changes, the development of specialized vending services,the rising emphasis upon foreign markets, and the like. Enough has been said, however, to demonstrate that the processing and marketing industries have been going through changes that are perhaps even greater than the changes that the farmer himself has witnessed in his own technology and practices.

Farmers Are Adjusting

Since we are all familar with the major changes that are occurring in the physical nature of products, the method of handling them, the direction of product flows, and the like, I would like to look at something less obvious—the changing ***business arrangements and relationships*** that have accompanied these developments. Without trying to assign an order of importance nor to be rigorously complete in the list, I am sure that an impression can be conveyed by the following types of arrangements: (1) corporate farming; (2) contract growing or processing arrangements; (3) multiple credit arrangements and innovations for financing growing crops, poultry, etc.; (4) expanding fields of cooperative activity; (5) special sale and lease arrangements for farm equipment and other capital items; (6) purchase of more and more farm input requirements such as fertilization, weed and pest control, etc., often to be applied by outside contractors; (7) special farm management services, for a fee; (8) numerous contracts, loans, and other commitments involved in participating in government programs.

All of these represent what might be referred to as institutional arrangements which have been changing just as technology and producing practices have been changing. They represent the business arrangements whereby farmers and others have been enabled to participate in the adjustments that are occurring. In an even more important sense they represent devices which knit together the agribusiness complex. They introduce new dimensions to markets and to the marketing process.

It will be noticed that the list does not include what our predecessors in the economics profession would have placed in the first position in any such list—namely, the simple buying and selling of goods in a commodity market on a spot basis. We can see that many new variables are introduced by the changing institutional patterns outlined above. With

these changing patterns it is necessary to provide new information on quality and grades, new specifications as to terms of trade and delivery, new arrangements for meeting quantity requirements on an efficient basis, new concepts of who will bear risks, new shifts of critical decision points.

The broiler industry has been notorious in recent years and perhaps it deserves this notoriety because of the very numerous changes and new arrangements that have been introduced. It is not especially significant to argue whether a particular arrangement represents forward or backward integration. It is much more useful to examine whether the entire process is well adapted to serve consumer markets effectively and whether the functions that have been thus knitted together can provide dependable services on a basis that is profitable to those participating. No one can study the broiler industry without having a new awakening as to the scope of competition, the numerous channels through which it functions, the importance of forward looking decisions and free choice among alternatives for all those involved.

Conclusion

From what has been said we must conclude that the farmer has been woven into the web of the agribusiness complex whether he likes it or not. Like most major changes that occur in our economy there are certainly pressures and various degrees of compulsion. In a very real sense they are the competitive pressures through which today's market economy works. My own examination of the changing face of the food industry has led to a conviction that the dimensions of competition are indeed much more numerous than they have been pictured in even the most sophisticated or economic theories. Despite the many new ties and commitments which involve not just the farmer but all of his partners in the agribusiness complex it seems clear that we do still have a very effective competitive system, a freedom of choice, an ease of entry, an access to resources, and all the other requirements for people to function effectively and efficiently. The major point is that these changed conditions and arrangements require each of us, including the farmer, to look again at the elements that enter into important decisions. They increase the need for emphasis upon proper planning, upon analysis of commitments before they are entered, upon an effort to look ahead and anticipate those demands that will provide favorable opportunities in the future and those adjustments which will offer competitive advantages.

All that I have said can be interpreted as a challenge to up-date our analytical thinking to keep pace with what is in fact happening in the competitive process. Indeed the very vitality and revolutionary nature of the changes that have been occurring are one of the greatest testimonials we could devise to the effectiveness of this complicated free

market economy which we, in the western world, have espoused. The whole system attains an ever changing but effective integration—not the integration of corporate mergers or of farmers deprived of their independence and professional self respect, but the integration which without a state-control blueprint can provide a progressive, efficient, dynamic response to the changing requirements of the world we live in. This kind of integration I favor, and if I were farming I would be proud to be a part of it.

DISCUSSION: INTERRELATIONS OF FOOD MARKETING AND FARMING IN THE AMERICAN ECONOMY

W. E. HAMILTON
American Farm Bureau Federation

The papers we have just heard present a provocative and challenging picture of the changes taking place in the food industry.

Both authors have stressed the interdependence of various segments of the agribusiness complex and the resulting tendency for changes in one segment to force changes in other segments. Both foresee continuing pressure for fundamental changes in traditional ways of doing business. Both have referred to the development of institutional devices and arrangements that probably will produce a much greater coordination—or integration—of the production, processing and distribution of farm products in the future. The big difference between Professors McCorkle and Arthur appears to revolve around the effect of changing conditions on competition at various levels in the food industry.

McCorkle finds the farmer typically "is faced with an oligopsony with a nearly competitive fringe"; the primary producer's bargaining power has tended to become relatively weaker in many areas in recent years; and "increased exertion of buying power by various elements in the food industry" is to be expected.

On the brighter side—from the farmer's viewpoint—he finds "collective action by producers in some limited lines of production and in some areas has provided various degrees of market power"; market-induced changes are not necessarily injurious to individual producers; and "the greatest benefits from changes in the food market structure have undoubtedly accrued to American consumers."

The conclusion that greatest benefits have accrued to consumers seems to suggest that the food industry has operated in a rather competitive fashion despite the existence of varying degrees of market power in some areas. Arthur supports this view with the conclusion that "the di-

mensions of competition are indeed much more numerous than they have been pictured in even the most sophisticated of economic theories."

Many of the changes currently taking place in the food industry involve what has been called "vertical integration." McCorkle made only a passing reference to the term. Arthur avoided it by defining integration as "the summation of all of the ties which relate the ultimate consumer to the resources that are to be employed in serving him." This broad definition calls attention to the fact that, under a market system, the consumer and producer are necessarily tied together by a chain of interrelationships, but it diverts attention from the importance of the changes currently taking place in the nature of some of these interrelationships.

While I do not wish to quibble over terminology, I do think it important to distinguish between informal interrelationships that develop more or less automatically in a market system and arrangements that have been institutionalized. This apparently is the objective of those who use the term "vertical integration" to describe situations in which two or more steps in the production and marketing process are tied together by common ownership or contract.

Vertical integration, as thus defined, is a matter of serious concern to farmers. It leads to fears that the individual farmer may be forced to compete with larger and stronger integrated units; that such firms may be willing to use processing and distribution profits to offset losses on farm production; and that the farmer may be in danger of losing his traditional independence to suppliers, processors and distributors who would subordinate his welfare to their own.

Assuming relatively competitive conditions, such fears probably are unwarranted. It is, of course, true that many processors and distributors can easily withstand losses that would bankrupt most farmers. In a competitive system, however, it is unlikely that any firm would incur such losses as a matter of policy. Processing and distribution margins tend to be low in the food industry, and management generally is under pressure to eliminate losing operations. As McCorkle has noted, however, integration can create serious marketing problems for unintegrated producers.

If producing to specification increases his income, the average farmer undoubtedly can be reconciled to contract provisions which reduce his freedom to make independent decisions. This apparently has happened to some extent in the broiler industry, as McCorkle finds many producers "now enjoying a higher income with less uncertainty than they had previously known."

Much of the concern that has developed with regard to the effect of vertical integration on the income of broiler producers undoubtedly reflects the rapidity with which cost-reducing technological changes have taken place, and the limited alternatives available to many producers

and potential producers. The existence of substantial underemployment in rural areas undoubtedly has weakened the bargaining power of broiler producers.

The trend toward closer relationships between producers, processors and distributors may open the way for farmers to improve their economic position by doing a better job of tailoring their production to effective market demand.

Professor Arthur has mentioned the possibilities of brand identification and product differentiation. In the past, farmers all too often, have produced undifferentiated products that do nothing to develop customer loyalty. By producing to specification for branded distribution in integrated operations farmers can tie their own operations more closely to the requirements of a specific sector of the market.

Contractual arrangements may also provide a mechanism for adjusting the volume of production to market requirements. One of the fundamental differences between agriculture and industry is that much of industry produces to fill orders, while the average farmer produces to employ resources, then looks for a market for his output. The all too frequent result is overproduction and low prices, followed by excessive cutbacks in production which push prices up and induce another round of overproduction.

Thus, there appears to be a great opportunity to reduce fluctuations in farm prices through contractual arrangements with market agencies, provided the objective is to find the equilibrium price rather than to fix prices at an artificial level. The difficulty of developing such arrangements will vary greatly from commodity to commodity; however, the American Farm Bureau Federation is so impressed with the possibilities that it has organized a marketing affiliate for the purpose of strengthening producer efforts to develop contractual arrangements with market agencies.

Farm Bureau is well aware of the difficulty of the task it has undertaken. The history of efforts to strengthen farm bargaining power is strewn with failures. While the current trend toward closer relationships between producers, processors and distributors may improve the opportunity for successful bargaining activities, success in this kind of an effort can be achieved only if the bargaining association can render a real service to its members and at the same time meet the competition of nonmembers.

The present farm income situation and the fact that the demand for most farm products tends to be inelastic—particularly in the short run—create a strong pressure for some kind of supply management. The available alternatives appear to be government coercion or the development of voluntary contractual arrangements. Some will suggest that the job could be done by organizing farmers along labor union lines. It is doubt-

ful, however, that labor union methods could be made to work in agriculture without the backing of a government program.

Government efforts to improve farm bargaining power lead to well-known problems. Not the least of these are the long-run implications of employing political processes to divide up the right to produce farm products, and the tendency for program benefits to be capitalized into land, or certificate, values. The value of milk "shipping rights" in the Los Angeles area, cited by McCorkle, is a good example of the capitalization of the benefits of a restrictive program.

The alternative of strengthening farm bargaining power through the development of bargaining associations to negotiate contractual arrangements with market agencies is not spectacular. At best it will be a long and slow process. Nevertheless, the long-run potentialities of achieving real and lasting gains appear greater for an approach that is designed to improve the operation of the market system, than for the government control approach.

HOW WELL DO THE ECONOMIC INDICATORS INDICATE WHAT IS HAPPENING IN THE MAJOR SECTORS OF THE ECONOMY?*

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ECONOMIC INDICATORS IN AGRICULTURE—PRAISED AND APPRAISED

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IN THE Foreword of each of the ten volumes of Agriculture Handbook 118, the first statement reads: "We in the United States probably have the best agricultural statistics in the world."[2] Most persons would agree with this statement, and few would disagree with it even if the qualifier "probably" were dropped. It is true also that agricultural statistics in the United States are as complete as those for most of the major industries in the world. Furthermore, improvements in them have been made through time, and new statistics have been developed. Many tradesmen, private managers, public administrators and researchers are engaged in activities that make them heavily, and sometimes wholly, dependent upon the official measures and estimates from our government. Seldom do these persons or others seriously question the accuracy of these statistics or even the honesty, the motives, the ability or the integrity of the many dedicated workers who are engaged in their production processes. Even when a statistic is questioned by an "outsider," he often learns that those on the inside are much more aware of its limitations and its mis-uses than he.

All of this is not to say that the system is flawless or its personnel perfect; neither is it to say that improvements can not or should not be made. As our agricultural economy has grown its service needs have changed, and in many instances the new needs have not been fully satisfied. Statistics are one of the economy's important service needs, and they have not always kept pace with the changes. As professionals interested in at least the technical and economic aspects of statistics, it is our joint responsibility to insure that they are the best that can be generated, for present and anticipated needs, with the resources which can be devoted advantageously to this purpose.

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* Joint Session with the American Statistical Association.

[1] Acknowledgement is given to my colleagues at Michigan State University, James A. Bonnen, Dale E. Hathaway, Glenn L. Johnson, Ralph A. Loomis and James D. Shaffer, who read early drafts of this paper and offered helpful suggestions.

[2] U.S.D.A., *Major Statistical Series of the U.S. Department of Agriculture,* Agr. Handb. No. 118, Vols. 1-10, 1957-1960.

Time (both of the author to research and of the audience to listen), journal space and the subject of this session impose restrictions on this paper. First, note that the title is "Economic Indicators in Agriculture"—not "*for* Agriculture." Indicators in other segments of our economy are sometimes better indicators *for* agriculture than are those *in* agriculture. Secondly, description of what's, why's, when's, where's, how's and with whom's are kept to a minimum. These are thoroughly covered in published materials.[3] Finally, of the dozens of measures that are important, only some aggregates for certain kinds of indicators will be considered. They will be dealt with under the three headings: Output Indicators, Input Indicators, and Ratio and Difference Indicators.

Output Indicators

Of the groups of indicators considered in this paper, the indicators on the output side rank as the best, the most used and the least misused. Look at one, the index of prices received by farmers. It is widely used and has legal status. It has a broad base—fifty-two commodities representing more than 90 per cent of the cash receipts from farm marketings. To the index number producer, it poses relatively few problems. The component commodities remain fairly homogenous through time and good check data exist for most individual commodity prices and quantities sold. The occasional headache that comes along is minor and is caused by such things as (1) changes in methods of sale which create difficulties of pricing, and (2) the technical problems of index number construction. In short, as an economic indicator the aggregate index, along with its sub-indexes, performs relatively well, and to reopen the oft-hashed conceptual and measurement problems would be inappropriate and outside the context of this paper.

As physical measures of quantity on the output side, the indexes of crop production, gross farm production and farm output are fairly adequate. Quality-wise, the index of crop production rates higher than the other two. It measures crop production on *farm land.* By definition the difficult problems of measuring and weighting the production of pasture lands (as is necessary with the farm output index) or with worrying about "producer goods" (as is necessary with gross farm production) are excluded. For the farm output index there are difficulties in estimating the amount of crop production consumed by livestock. But for all three indexes, the basic data for acreages harvested and yields are reasonably accurate, and for the important crops in the South and Midwest, these basic data have been much improved by the modifications in sampling and in measurement introduced through the research program initiated

[3] *Ibid.*

in 1952 by the Agricultural Estimates Division. Inventory data needed for the farm output index pose some, though not serious difficulties in terms of their physical measurement and their pricing.

Cash receipts from farm marketings are pieced together from the raw price and quantity data just described. The U.S. aggregate is built up commodity by commodity and state by state, and even though the raw data are not gathered specifically for this purpose, the gaps that exist have little influence in the totals. Gross farm income is equal to the cash receipts from sales of commodities plus two items—the value of farm products consumed in the home and the rental value of farm housing. They both pose measurement difficulties and because of their magnitudes, are important in the total. The measure, gross income for the farm population includes gross income from farming plus the income of farm people from nonfarm sources. For this latter component, the data and methods are crude indeed. With the aid of scattered bench-mark surveys, the data are interpolated and extrapolated on the basis of the ratio of farm to nonfarm population. Income from nonfarm sources now constitutes an estimated one-third of the total;[4] therefore, the figure for this component must be accurate in order to achieve reasonable over-all accuracy in the estimate of gross income for the farm population. As of now, however, one is left with an uneasy feeling about its reliability.

Input Indicators

If the output indicators sometime cause minor headaches and uneasy feeling the input indicators can easily cause chronic sinusitis and near frustration. The parity index, though companion to the index of prices received by farmers, poses more difficult construction and measurement problems. Whereas the physical measures on the output side are sure-treaded, by contrast, the physical measures on the input side lack traction. The sources of possible errors in measures of gross farm income are few compared with those for gross farm expenses.

Why the differences? The reasons are many, but they include the following two. (1) The early interest of users was centered largely upon measures of output and its components, therefore less attention was devoted to measures of input and its components. In early years, a higher proportion of the inputs was farm-produced and therefore not as significant to the industry's welfare. The input side, particularly since the beginning of World War II, has undergone substantial change, both in terms of over-all magnitude as well as make-up.

(2) The problem of measurement is difficult, especially for non-purchased, fixed and intangible inputs.

[4] U.S.D.A. *Agricultural Outlook Charts, 1961,* Table 11, p. 60. In 1959, total income per capita equalled $965; income from non-farm sources was $321.

Let's look more closely at some of the indicators relating to farm inputs. The parity index contains major sub-indexes for prices paid for purchased items used in production, items used in family living, and in addition, interest, taxes and wage rates. In pricing the items for both the production and family living categories, price reporters are asked to report prices for the qualities most commonly purchased by farmers. Conceptually, a bias is introduced through price—its magnitude dependent upon how much actual purchases vary in quality within the limits specified. Griliches[5] has compared items in the production component of the parity index as nearly as possible with the same items in the wholesale price index of the Bureau of Labor Statistics, and for 1958 found the U.S.D.A. index to be ten points (7 per cent) higher on a 1947-1949 base. Upward biases adjudged to be due to quality were found, (a) for automobiles of 50 to more than 400 per cent over 13 and 9 year periods, depending upon the method used; and (b) for labor, when the factors of education and sex were considered. A downward bias of 6 per cent for the period 1940-1959 was noted in the U.S.D.A. fertilizer index because plant nutrients are assigned equal weights when in fact they have quite different effects. There are other ways to check the actual amount of bias in the index of prices paid for items used in production as well as the entire parity index. These should be but unfortunately cannot be explored here.

Other problems associated with the construction of index numbers, namely linking, weights, formulae, base periods, and the handling of heterogenous commodities, are more acute with the parity index than with the prices received index. It is important to remember that the basic data needed to evaluate the index on a current basis are not regularly available. Periodic bench-mark surveys are relied upon, together with incomplete and intermittent data from the census and other sources.

Until recently, physical input series were available only for man-hours of farm work, number of farm machines, amount of electricity, use of fertilizer and lime and animal units of breeding stock. The man-hours data are synthesized and pieced together on the basis of enterprise requirements based upon assumed levels of technology. The number of farm machines is assembled from a variety of sources and is unweighted by qualities. The fertilizer consumption measure was estimated for early years from several sources, but beginning in 1943 reports from fertilizer producers have been obtained and used. Each yearly total is an unweighted sum of total pounds of the three most important plant nutrients.

An aggregate physical input series now has been constructed and pub-

[5] Griliches, Zvi, "Measuring Inputs in Agriculture: a Critical Survey," *J. Farm Econ.*, 42:1411-27, Dec. 1960.

lished for the years beginning with 1910.[6] It contains six major subgroups. Magnitudes and/or weights for too many of its items must of necessity be measured arbitrarily. Unpurchased input items presented the greatest difficulties. First, the quantities of unpurchased labor and capital used were estimated. They were then weighted into the total index by the prices of *purchased* labor and capital, thereby treating the unpurchased factors as identical to those purchased. Because unpurchased inputs are still 37 per cent[7] of the total, small errors of measurement in these items can cause rather large errors in the over-all index. The unpaid capital item alone is 42 per cent of the total of unpaid inputs.[8] Its influence in the total index is therefore $.37 \times .42$ or .156.

Total expenditure and cost data are built up from the available physical input data multiplied by market prices or imputed values. Periodic benchmark surveys plus census data are used as bases from which interpolations and extrapolations are made. Therefore, errors in the individual items may be magnified in the totals, though in some instances they may be offsetting. Incidentally, the price data with whatever quality bias is present need not, and likely do not, introduce bias into the expenditure series. The price, based upon the concept "most commonly bought" should, when multiplied by physical units of inputs purchased, yield relatively accurate expenditure estimates. The difficulty with the existence of a quality bias arises more from other uses for the prices or their relatives, such as deflating other series, measuring demand for inputs and weighting physical inputs.

Conceptually, prices and costs are quite different, but because price is a component of cost the two are related. If prices are measured by an index, the nature and extent of the relationship depends upon how "fixed" the quantities are in a price index, or from the other side, how variable the quantities are in the measurement of cost. The price index for commodities used by farmers in production including interest, taxes and wage rates is composed of almost the same set of items used in computing farm production expenses, net of government payments to nonfarm landlords. One series plotted against the other for the years 1910 to 1959 yielded three highly significant linear relationships (Figure 1). Each relationship was determined by the sets of years for which given quantity weights were in use in the price index–1910-1935 with weights based upon 1924-1929, 1936-1952 with weights based upon 1937-1941, and 1953-1959 with weights derived from 1955 data. For each of the periods, the correlation coefficient was almost equal to 1.00 (Table 1, Column 1). The

[6] *Agricultural Outlook Charts, op. cit.*, Table 21, p. 63.
[7] *Agricultural Outlook Charts, op. cit.*, Figure 33, p. 17.
[8] Loomis, Ralph A. and Barton, Glen T. "Productivity of Agriculture, United States, 1870-1958," Unpub. ms., Farm Economics Research Div., Agr. Res. Serv., U.S.D.A.

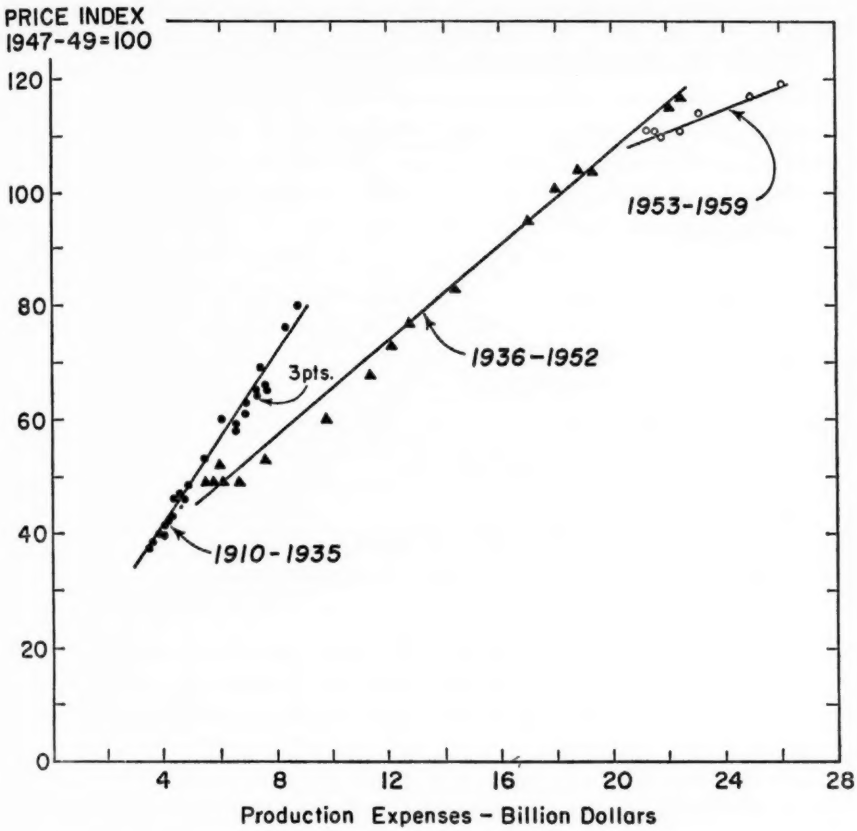

FIGURE 1. RELATIONS BETWEEN INDEX OF PRICES PAID BY FARMERS FOR ITEMS USED IN PRODUCTION INCLUDING INTEREST, TAXES, AND WAGE RATES AND TOTAL FARM PRODUCTION EXPENSES, NET OF GOVERNMENT PAYMENTS TO NON-FARM LANDLORDS, UNITED STATES, 1910-1959.

closeness of the relationships is less surprising than the nature of the relationships. Why should they be linear? Linearity in these relationships indicates hyperbolic relationships between prices and quantities (Table 1, Column 3 and Figure 2). Several conclusions can be drawn from the relationships.

1) The elasticities of expenses and of physical quantities increased from one period to the next. Whereas the elasticity of quantity on price was less than one in the earliest period, it was greater than one in part of the 1936-1952 period and in all of the latest period.

2) Changing weights in the price index had injected marked discontinuity into the functional relationships between prices and expenses—a discontinuity which is probably more abrupt than it should be. More fre-

Table 1. Relationships Between Index of Prices Paid by Farmers for Items Used in Production Including Interest, Taxes, and Wage Rates, and Total Farm Production Expenses, Net of Government Payments to Non-farm Landlords, United States, 1910–1959

Period	Correlation Coefficient	Regression Equation: Prices on Expenses	Regression Equation: Prices on Quantities
	(1)	(2)	(3)
1910–1935	.993	$P=11.4+7.83E$	$P=\frac{11.4}{1-.01323Q}$
1936–1952	.996	$P=23.3+4.18E$	$P=\frac{23.3}{1-.00750Q}$
1953–1959	.985	$P=70.1+1.87E$	$P=\frac{70.1}{1-.00335Q}$

Source of Raw Data: Prices Paid—U.S.D.A., *Agricultural Prices, 1959, Annual Summary*, June 1960, Table 9, p. 13. Farm Expenses—U.S.D.A., *Farm Income Situation*, July 1959, Table 14, p. 47 and July 1960, Table 15H, p. 46.

Col. (2): P=prices expressed as percentage of 1947–49=100; E=farm expenses in billions of dollars.

Col. (3): P=prices, Q=quantity, both expressed as percentages of 1947–49=100; Q was computed by deflating E, 1947–49=100, by P, 1947–49=100. Elasticity (ϵ) of Q on P can be computed from $\epsilon=\alpha/\beta PQ$, where $\alpha=P$ intercept (numerator of equations), β=coefficient of Q.

quent revision of the weights in the price index may be necessary.

3) The upward slope of the price-quantity relationship indicates that the demand relation for inputs has been shifting more than the corresponding supply relation.

As an aside, the variability in the quantity index derived above is about twice that for the aggregate input index. Obviously, the inclusion of unpurchased capital and labor inputs injects a high degree of stability into the input index. This is additional evidence which causes one to hold the input index in suspect.

Ratio and Difference Indicators

Only two ratio indicators will receive comment. The first is the parity ratio, computed by dividing the index of prices received by farmers by the parity index. If the parity index contains an upward bias, the parity ratio would as a consequence contain a downward bias. A downward bias from this source could be offset partially by an upward bias resulting from the inability to keep the quantity weights in the parity index current. This latter kind of bias probably exists also in the companion prices received index, but to a lesser extent. If so, the two would tend to be offsetting forces in the parity ratio.

The parity ratio, conceptually, is quite different from net farm income measures. Yet over time the correlations between the parity ratio and net farm income measures have been high and the regressions posi-

tive.[9] In addition, the relationships have been shifting. Substantially higher net farm incomes existed in the post-World War II period compared with earlier periods. In other words, net farm incomes have tended to advance even though the parity ratio remained constant or fell. If a net downward bias in the parity ratio persists through time, this would help to explain its shifting relationship with net farm income measures. Other factors, such as shifts in the physical production functions, likely are more important, however.

The second ratio which bears comment is the index of physical farm outputs divided by the index of physical inputs. This ratio is used to measure changes in productive efficiency. It is likely that the changes are overstated rather than understated. Both indexes are price-weighted

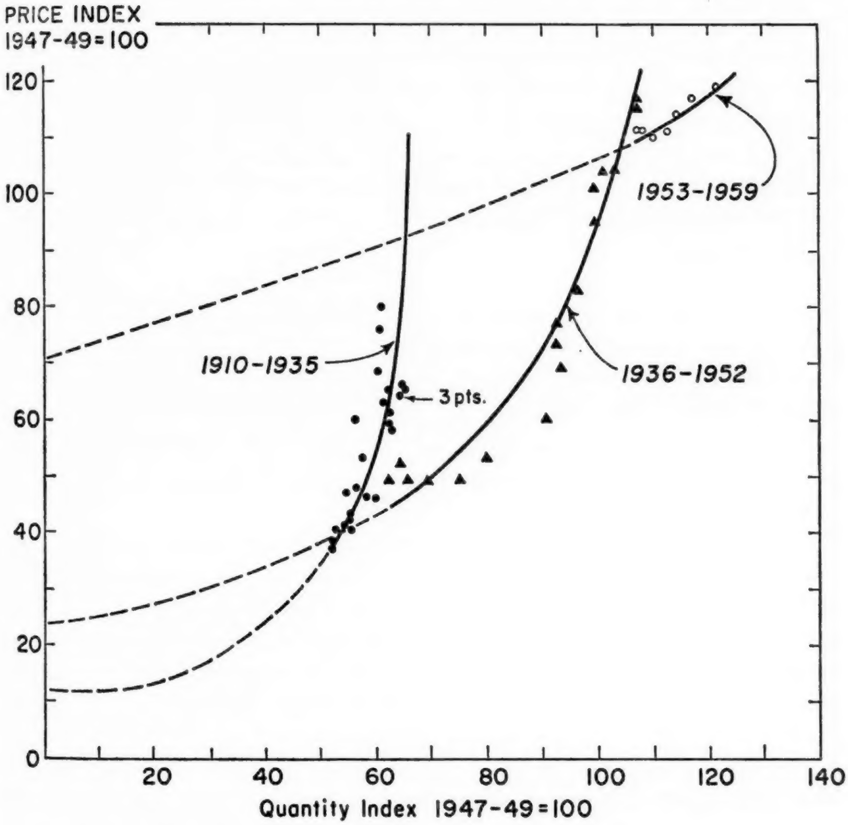

FIGURE 2. RELATIONSHIPS BETWEEN INDEXES OF PRICES PAID BY FARMERS FOR ITEMS USED IN PRODUCTION INCLUDING INTEREST, TAXES AND WAGE RATES AND PRODUCTION EXPENSES (FIG. 1) DEFLATED BY PRICE INDEX, UNITED STATES, 1910-1959.

[9] Ruble, William L. "A Comparison of the Parity Ratio with Net Income Measures, 1910-1958," *J. Farm Econ.*, 43:101-12, Feb. 1961.

and some have argued that this injects a bias into the ratio because the relative movements of prices have changed through time.[10] The weighting of unpurchased labor and capital inputs with market prices probably understates the quantity of inputs employed. Also, the absence of intangible capital inputs would have the same effect.

Net income measures, as differences between comparable gross income and expenditure or cost measures, are widely used. In recent years the greatest changes in agriculture have taken place on the expenditure and cost side—the side for which data are poorest. In addition, expenditures or costs have been running about two thirds of comparable gross income measures. Relatively, then, an error in estimating expenditures and costs leads to one twice as large in the net income measures. Remember, too, that the estimating methods for off-farm income are rough. In addition, the demands for reporting net income estimates on per capita, regional and state bases lead to thinner estimates and introduce the likelihood of other errors. In brief, the aggregate measures of net farm income are open to the compounding of errors creeping in largely on the expenditure and cost side. To a lesser extent, ratio and difference indicators suffer, as do other measures, because users demand and get estimates at higher levels of disaggregation than the data can supply and still contain low levels of error.

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Now to return to where we started: Agriculture need offer few apologies for the relative quality or absolute quantity of its aggregative economic indicators, and not many for their absolute quality. And those for which apologies must be made, can be improved. Some of the problems are difficult indeed, but for most, the pay-off is high. Without belaboring too many specifics, the quality of aggregative indicators could be enhanced by:

(1) Improving expenditure and cost data. Data need to be broad-based, current, regular, and kept abreast of recent developments and extensions of economic theories. A continuous reporting system, established with sound sampling procedures, could supply the needed data from the commercial farm sector. These data could be supplemented by regular surveys covering the non-commercial farm sector. Three important benefits would result. First, net income estimates would be improved; second, the parity index could be re-weighted on a regular and more current basis; and third, better data would be available for supply response studies.

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[10] See for example, Griliches, Zvi, "Specification Bias in Estimates of Production Functions," *J. Farm Econ.*, 39:8-20, and Stout, T. T., and Ruttan, V. W., "Regional Patterns of Technological Change in American Agriculture," *J. Farm Econ.*, 40:196-207.

(2) Improving price indexes. Research is needed on conceptual problems relating to index number construction. Companion indexes needn't be treated as twins. The differences between the prices received and the parity indexes outnumber the similarities. The parity index, as mentioned in Point 1 above, needs attention regularly. Also, more experimental work on the inclusion of non-purchased inputs is needed.

(3) Providing a basis for reliable estimates at less than the national level. It may become necessary to calculate parity income levels by regions, states, counties or even types and classes of farms. Furthermore, wide regional variations exist on both the input and output sides. Input and output categories gyrate through wide limits and respond differently during periods of business expansion, as compared with periods of business contraction.

(4) Expanding objective methods for determining acreages and yields for all major crops in the United States. Good progress has been made in implementing results from the research program in the Agricultural Estimates Division. More commodities and the rest of the states in the United States need to be added.

(5) Improving estimates for certain measures in the inter-census years. Involved here are measures for such things as farm population and number of farms. Per capita and per farm estimates would be improved materially.

This list is far from complete. It is a start, however, and when completed will not only provide the basis for improving the "Economic Indicators in Agriculture," but in addition will lead to more analytic research, more accurate projections, and thereby provide better antidotes for the ills of agriculture.

ECONOMIC INDICATORS FOR LABOR

STANLEY RUTTENBURG
AFL-CIO

IN THIS paper, I intend to discuss two of the major economic indicators—corporate profits and unemployment. In addition, I have a few general suggestions to offer that might make the Federal statistical program more valuable to its users.

Corporate Profits

The major fault of the current series on corporate profits is the time lag. According to the Commerce Department, the figure for the third quarter of this year probably will not be available until late in January 1961[1]—a lag of four months following the end of the quarter.

The lag in publication of information on corporate profits is a handicap to those attempting to interpret current trends in economic activity. Early last fall, some analysts predicted, on the basis of various corporate financial reports appearing in the newspapers, that profits would be lower for the third quarter. However, as this is written, we still do not have confirmation of this judgment, and it is already time to be concerned about what fourth quarter profits will be. The National Bureau of Economic Research includes the series on corporate profits in its latest (1960) group of leading indicators. However, a figure which appears in January and tells us what a leading indicator was doing in August loses most of its value for predicting future trends.

It should be recognized that the lag has been reduced in recent years, but it remains greater than that for series with which it is usually compared. For example, a glance at the November Economic Indicators reveals that the estimate of national income for the third quarter has not been prepared because of one missing component—the figure for corporate profits.

Total corporate profits are estimated on a quarterly basis by the Office of Business Economics of the Department of Commerce, using data on different industry sectors which are collected from a wide variety of sources. This information is then applied to detailed benchmark data computed by the Internal Revenue Service from corporate income tax returns, the final figure being published as a seasonally adjusted annual rate.

Formerly, the benchmark material was not available until almost two years after the year to which it applied. The lag in the availability of the

[1] The third quarter figure was issued *Dec. 15*, after this paper was prepared. For the first time the lag has been cut to 2½ months—an improvement that I hope continues, but in any case the time lag could be cut further.

benchmark material has now been reduced; while this allows revisions to appear sooner, and improves the quality of quarterly estimates, it does nothing to reduce the lag in the preparation of the current quarterly figure.

The only really solid data on which current quarterly estimates are based comes from the Federal Trade Commission–Securities and Exchange Commission sample of manufacturing corporations, which account for about 60 per cent of all corporate profits. The SEC obtains reports from those corporations listed on security exchanges, while the FTC is in charge of collecting information from all others. Naturally, the responsibility of the FTC extends to many more corporations, including not only most all of the smaller ones but also some of our largest.[2] However, the SEC portion of the sample accounts for the bulk of corporate profits.

The date of publication of the FTC-SEC financial report for manufacturing corporations is determined by the time required for the collection of reports by the SEC. I understand that the SEC report is held up because of several large corporations which find it physically impossible to compile data from all their operations. However, if a global estimate for manufacturing were prepared without waiting for this information, the FTC-SEC figure for corporate profits could be made available about six weeks following the end of the quarter. This would in turn allow the Office of Business Economics to publish a figure at least a month earlier than the present practice.

The preparation of such estimates by the FTC and SEC is not now carried out because of the pressure to compile detailed industry breakdowns as soon as possible. If a global figure for manufacturing were prepared separately, it would entail the delay of a few days in the *Quarterly Financial Report*. Thus the problem is one of priority. We feel that the completion of the nation's economic accounts almost a month earlier than is now the case is worth delaying the detailed report by only a few days.

Improving non-manufacturing corporate profits.

In addition to reducing the lag for published figures on corporate profits, it would be desirable to improve the quality of the estimates for the non-manufacturing sectors of the economy, which account for 40 per cent of all corporate profits. The data for retail and wholesale trade, which account for about 16 per cent of total corporate profits, is particularly poor. The following procedure for estimation of profits in wholesale trade is quoted from *National Income* (page 96).

Basic year profits estimates (latest available income tax data) are extrapolated

[2] Those large corporations such as Lever Brothers, Hughes Tool Co., and until recently, Ford, which have never issued stock for public sale.

by tenuous procedures involving, in general, indicators of total sales adjusted for *probable* changes in profit ratios. (emphasis supplied)

This method is also applied to a part of retail trade. It is not surprising that experience has shown that large revisions are required when tax return data becomes available.

In view of the excellent reliability of the current data for manufacturing and the poor reliability of present data for retail and wholesale trade sectors, it is indeed regrettable that the FTC sampling program of several years ago, covering these two sectors, has been discontinued. Congress has specified that none of the funds appropriated for the FTC be used for this purpose. Since improvement of data on profits in trade is necessary in order to improve the figure for total corporate profits, the FTC program for collecting data on retail and wholesale trade sectors should be re-established as soon as possible.

Depreciation evaluation adjustment

Another problem with current methods of reporting corporate profits is the amount of depreciation allowances. Substantial changes in the method of computing depreciation will affect the amounts of profits reported even though there may be no change in the profit position of the firm. For example, under the 1950 provisions for rapid amortization of defense facilities and the 1954 law allowing use of other than straight-line depreciation accounting methods, corporate profits were reported to be considerably below what they would have been had they been calculated on the old basis. This immediately presents the problem of non-comparability of data for various years.

One way to deal with this problem would be to develop a depreciation adjustment to corporate profits. This might be along the line of the present inventory evaluation adjustment which is intended to make allowance for the effects of changing values of inventories. This would mean that the increased depreciation resulting from tax-law changes would be added to reported corporate profits to get a series that would be comparable with the pre-1950 period.

Current practice is to publish corporate profit figures apart from those for depreciation. This tends to obscure the relationship between the two. If total corporate profits (after taxes) were published alongside of depreciation allowances—with a third adjoining column supplying the total for the two—it would highlight the problem of changing profits totals due to changing accounting practices. Then it might also be possible to publish the depreciation figure according to any of several methods of computation.

At any rate, the total of profits after taxes and depreciation provides a measure of the flow of funds to corporations. In the flow of funds to

corporations as now published, the concept used includes only retained (not total) earnings plus depreciation, reflecting not total funds *available* to corporations internally but only total funds *used* from internal sources.

Unemployment

Another extremely important economic indicator is unemployment. There are improvements that could be made both in unemployment data and in labor force data which would make the figures convey more accurately the state of employment prospects in the economy.

The actual increase in the labor force during 1955-1956, when the economy was operating at a relatively high level of activity, was 695,000 greater than projected on the basis of previous trends and available population data. By contrast, in the last five years, when job prospects have been favorable only for relatively short periods, the increase in the labor force was 1,348,000 *less* than projected by the U.S. Department of Labor. The explanation for this is that many people enter the labor force only when it appears that there is a good possibility that they can find employment. When measures to promote economic growth are subjects of considerable controversy, we need to know the extent to which we have a surplus labor supply, which, if put to work, would greatly increase our rate of growth.

I think that the current Census survey does not count all the persons who should be in the labor force by the Census' own definition. For example, persons who are not employed must be actively seeking work to be classified as unemployed and as in the labor force. If they are not seeking work, they are not considered to be in the labor force. However, an exception is made for those persons who are not seeking work because they are awaiting the result of a job inquiry or who do not seek work because they do not believe it exists in their occupation or community. As I understand it there is no specific question included in the survey on this latter point; the information is recorded only if the respondent happens to volunteer the information. If he does not do so, he is not counted as unemployed or as part of the labor force. Especially in distressed areas, as well as rural areas, the lack of information on these individuals may result in considerable undercounting of unemployment. The rate of unemployment, which is used as a measure of the employment opportunities in the economy, may well be distorted as a result of this undercounting.

Underemployment

The general level of economic conditions is reflected in job opportunities not only in unemployment but through underemployment. This can take the form of part-time jobs, or lower weekly hours on normally full-

time employment, or employment due to economic reasons of skilled workers in jobs which do not make use of the worker's full potential. We can now obtain from the Census Bureau a figure on the full-time equivalent of part-time employment, which is intended to help to put the problem of part-time employment (resulting from economic conditions, not from choice) on a comparative basis with unemployment information. This series is still not published.

Relatively little is known about the underutilization of employment skills. We urgently need a detailed study of the whole problem of underemployment before we really know what statistics we should gather. One way to get the necessary information might be through an historical record of work experience. At present we obtain a cross-section of the labor force. We do not know what happens to those workers who have been laid off in mass-production industries. Are they able to find employment at positions commensurate with their occupational abilities? Are they able to secure employment as readily as the labor force as a whole, or are they handicapped by possessing obsolete specialties?

Of course, I realize that it is probably not possible to obtain more material from the present Census sample. The present panel gathers information on a wide variety of subjects, and it is approaching the maximum number of questions that we can reasonably expect people to respond to during an interview. There has been support for adding a second panel to the survey in order to gather additional information. This should be given a high priority and when the second panel is added, it should be designed to yield information on the employment experience of the labor force.

Users' Needs and Statistical Programs

The statistical information available through government agencies today is, on the whole, quite satisfactory. There is a continuing problem of designing and adapting the federal statistical program to the needs of its users. One of the most promising developments in this regard has been the formation of the Federal Statistics Users' Conference. The Conference facilitates the communication of user needs to governmental statistical agencies, and allows those agencies to obtain an evaluation of proposed statistical programs in terms of usefulness to business, labor, and research organizations.

In order for the vast amount of published statistical information to be of maximum value to its potential users, it must be readily available to them. Unless one finds it necessary to obtain data on a wide and constantly changing variety of subjects, he may easily underestimate how time-consuming the location of a particular series which is known to be published can be. It is even more difficult, and often almost impos-

sible, to ascertain the full extent of available information in a field in which one is interested but not familiar. In Washington we solve the problem by placing a call to the proper agency, but in other parts of the country this is not an acceptable solution.

To alleviate this problem somewhat, the various federal statistical agencies should combine to issue a directory of available statistical information. Ideally, this should list each series published, together with the publications in which it appears. To some extent, the *Statistical Abstract of the United States* presently serves this purpose. Some agencies also make available their own lists. I am merely suggesting an expansion of these sources, to include, in so far as possible, all series published by the government (and since the government re-publishes most important privately-collected series, this would include most regularly collected statistical information).

A second problem that plagues users of some statistical series is compilation of time series from data that is published monthly, but is subject to frequent revision as additional information becomes available. For example, series for employment in individual industries are published monthly. However, an attempt to compile a time series over several years is a confusing, time-consuming process that usually leads to frustration of the compiler and error in his series. The series is subject to periodic revision when social security benchmarks become available. When the 1957 adjustment was completed, the revised figures for 1956 and 1957 for major industry groupings were published in the 1958 annual supplement issue of *Employment and Earnings*. The same procedure had been followed previously. In order to get data on industry employment that is completely comparable, it is necessary to know that one can use only a certain issue of *Employment and Earnings*—a special section which appears only once every two years. If the required data is for one of the finer industry breakdowns, the compiler has no recourse other than to place a special order to the Bureau of Labor Statistics, or if time does not permit this, to accept the error in the only published series.

Another example is the new series on housing starts. The *Construction Review* and *Construction Reports*, publications of two separate divisions within the Department of Commerce, have differing and confusing methods of presenting the same series. One plainly marks its latest figures as preliminary and marks some but not all revisions. The other apparently marks more revisions, but none are marked preliminary. Consequently when different figures appear for the same month with no mark of any kind in either publication, as has often been the case recently, one is at a loss to determine which figure should be used.

I would recommend that governmental agencies adopt a uniform method of introducing revisions, preferably by clearly marking figures

which have been revised since earlier publication. The periodic publication of collected time series, such as the Commerce Department's biennial *Business Statistics* and its *National Income* volumes, should be expanded by other departments so that comparable data over a period of years is always available for selection by users. It is not enough that more experienced users know where to obtain information; it should be obtainable as readily as possible by casual users, in order for the federal statistical program to achieve maximum usefulness.

DISCUSSION: ECONOMIC INDICATORS FOR LABOR

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1. Mr. Ruttenberg suggests that the current monthly estimates of unemployment are possibly too low, because the questions asked by the interviewers do not bring out clearly the fact that some workers who are genuinely interested in obtaining work make no effort to get a job; they feel sure that no work is available in their community at the time. He proposes that there be set up a special panel of families in order that more information might be obtained on this group of fringe or marginal unemployed.

No doubt there is a small but persistent number of workers who have had intermittent labor force activity in the past, who still have some interest in working, and who might be considered part of the current labor force if more precise information could be obtained about them. Therefore, I would endorse Mr. Ruttenberg's proposal for a special panel of households which could be used explicitly for labor force research. In the past, such research has been handicapped because additional questions dealing with labor force participation were known to affect the basic results from the labor force survey. This problem could be avoided if the households subjected to experimental questioning were not included in the basic panel of 35,000 households.

In the meantime, we do have some fragmentary evidence concerning this particular group of workers. Table 1 appears in a report compiled by the Bureau of Labor Statistics for the Joint Economic Committee (*The Structure of Unemployment in Areas of Substantial Labor Surplus, Study Paper No. 23)*. This table compares, by sex and by age groups, the civilian labor force participation rates in the spring of 1959 (average of data for April and May).

These data are based on the regular sample used for the monthly report of the labor force. The chronically depressed areas are the major areas so classified by the Bureau of Employment Security.

This table is quite significant in the picture it presents concerning labor force participation in areas where unemployment is high and has been so for a long time. Note first that the percentage of the total population in the labor force (57.3) is exactly the same for the United States as a whole as it is for the chronically depressed areas. Note second that there is a decline in the proportion of men (80.5 to 77.3) and a rise in the proportion of women (36.1 to 40.0). Note third that the decline in men in the depressed areas is evident in every age group, but is most significant in the

TABLE 1. CIVILIAN LABOR FORCE PARTICIPATION RATES, SPRING 1959

	United States	Chronically depressed areas
	per cent	
Total	57.3	57.3
Male	80.5	77.3
14 to 19 years	41.5	33.3
20 to 24 years	85.9	80.6
25 to 34 years	97.3	96.9
35 to 44 years	97.8	97.6
45 to 54 years	96.2	93.2
55 to 64 years	87.3	86.7
65 years and over	34.7	30.6
Female	36.1	40.0
14 to 19 years	26.1	28.7
20 to 24 years	44.2	58.9
25 to 34 years	35.9	35.7
35 to 44 years	43.5	50.3
45 to 54 years	49.7	57.0
55 to 64 years	37.5	42.2
65 years and over	10.5	8.3

young men under 25 years of age and older men over 65 years of age. On the other hand, there is a substantial increase in women in the labor force in nearly all age groups.

I venture the following interpretation of these data:

(a) Under conditions of severe unemployment the marginal women workers do enter the labor force, and our data substantiate that fact;

(b) Men of all ages, but particularly young men under age 25 leave the community in search of work elsewhere. Many of those no longer in school—especially the more active or enterprising youngsters—leave the depressed community to search for work elsewhere. It also seems likely that for those still in school in depressed areas, there would be fewer part-time jobs available than in more prosperous areas;

(c) Men over age 65 (and women, too) have retired on old-age and survivors insurance benefits.

There is another interesting point about the above table, namely, it supports the conclusions drawn from the experience of the depression of the 1930's—that the labor force expands in times of depression because housewives and students join the labor force when the head of the family is out of work. However, the experience of the past 20 years has been apparently that in mild recessions this labor force expansion does not occur. The above data seem to indicate that this expansion of the secondary labor force actually does occur during mild recessions among families where the head is out of work for an extended period, although this effect is not perceptible in the overall data. This tendency is offset by other marginal labor force members who either withdraw from, or fail to enter, the labor force because of discouragement over their job prospects.

TABLE 2. LABOR FORCE BY AGE AND SEX—ANNUAL AVERAGES, 1960

	Projected Averages[a]	Actual Annual Averages
	thousands	
Total	73,687	73,126
Male	50,051	49,507
14 to 19 years	3,955	3,821
20 to 24 years	5,042	5,089
25 to 34 years	10,943	10,930
35 to 44 years	11,383	11,340
45 to 54 years	9,699	9,634
55 to 64 years	6,483	6,405
65 years and over	2,546	2,287
Female	23,636	23,619
14 to 19 years	2,284	2,409
20 to 24 years	2,554	2,590
25 to 34 years	4,375	4,140
35 to 44 years	5,284	5,307
45 to 54 years	5,152	5,280
55 to 64 years	3,036	2,986
65 years and over	951	907

[a] Projected rates derived from Bul. 1242 applied to actual July 1, 1960 total population.

2. There is another scrap of evidence on this subject which tends to demonstrate the importance of the social security system. Some five years ago the Bureau of Labor Statistics made a projection of the labor force to the year 1960, basing it upon the previous experience in labor force participation. Now that 1960 has arrived we are able to compare our projections with the actual 1960 levels. Table 2 shows this comparison.

These figures indicate a deficit of over half a million below the projections. Note that the shortfall is due practically entirely to males; the female differential is negligible. Note further that almost half of the male

shortfall is among men 65 years of age and over, with an additional 12 percent among men 55-64 years of age.

Is there any factor which could account for this? The answer is—old-age and survivors insurance. In 1947, almost half the male population 65 years and over were in the labor force; in 1959, it was less than one-third. In 1947, only 15 percent of males 65 years of age and over were receiving old-age benefits; in 1959, it was 71 percent. In brief, the BLS projection was too high, mostly because it did not make allowance for the substantial numbers of older men (and to some extent older women) who have retired from the labor force in 1960 by qualifying for old-age benefits.

I must emphasize that I do not interpret these figures to mean that these older workers retire voluntarily and choose benefits instead of work. Furthermore, there surely are many of them who would (a) prefer to get a job if they could and (b) would like to get a part-time job to supplement their benefits. However, the figures seem to indicate quite clearly that in response to questions they do consider themselves to be retired and not in the labor force.

3. Mr. Ruttenberg has presented the case for computing a figure for unemployment which would include the full-time equivalent unemployment of part-time workers. This subject was taken up by the Joint Economic Committee in November, 1955, in the published report of the hearings before the Subcommittee on Economic Statistics. The appendix of this report contains a letter to Chairman Richard Bolling of the Subcommittee from Raymond T. Bowman, Assistant Director, Office of Statistical Standards, Bureau of the Budget, together with an analysis of the concept of full-time equivalent unemployment. (See pages 162-167 of the Hearings.)

By arbitrarily assuming a standard work week of 37.5 hours, the BLS has computed the full-time equivalent unemployment of persons working part-time for economic reasons (slack work, material shortages, inability to find full-time jobs, and the like). For October 1960 this would yield an estimate of about 1 million "fully unemployed workers" in addition to the 4 million who were totally unemployed in that month. We do now show estimated numbers of part-time workers, classified by the varying hours actually worked per week. Any one who wishes to do so can make this computation. On the other hand, there is a question in my mind as to whether it adds to public understanding to combine this hypothetical unemployment of part-time workers with the figure for total unemployment.

In the first place, from a policy point of view, the distinction between the completely jobless worker and the worker who is on short time is a very important one. The short time worker has a job which he might not

be willing to leave, even for another full-time job. He surely would not be available for any "made work" projects which might be established to help the totally unemployed. Different types of programs are needed to deal with the problems of these two groups. A measure which combines the effects of the two types tends to blur the picture. The actual figures are less sensitive to cyclical change than is the measure of total unemployment alone.

Furthermore, there are some technical objections to this procedure. One is that a certain proportion of the totally unemployed—somewhere between 10 and 20 percent, depending on the season and the stage of the business cycle—are seeking only part-time jobs. Theoretically, they should be deflated into a full-time equivalent. Second, a large proportion of employed persons work more than 37.5 hours (almost half in October 1960). A good many of them worked more than 40 hours and some of them held two jobs. If we wish to measure the capacity of the economy to provide the standard number of hours of work to each person in the labor force, some account should be taken of the hours worked above the standard.

Several methods of computing an index or rate of labor force time lost through unemployment and partial employment have been devised by labor force analysts. Although they all involve some arbitrary assumptions about the length of the standard workweek and the amount of time to be imputed to various groups, they provide a measure of the impact of reductions in the workweek which is in terms of a rate rather than in terms of numbers of "persons." We are working on the development of such a measure which might be suitable for publication.

4. My last point concerns the point made by Mr. Ruttenberg on historical compilations.

We are acutely aware of the frustrations of compiling series of data when the data are frequently subject to revision. Notwithstanding that a great many of these frustrations are inherent in the program, we are seeking means for making the task of securing continuous data less onerous. For example, in our next major revision of payroll employment data based on the new Standard Industrial Classification, we are going to try to publish all of the revised historical series in handy form, if our publishing resources permit.

BETTER ECONOMIC INDICATORS FOR INDUSTRY

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THROUGHOUT most of 1960 observers of the business scene were in sharp conflict regarding the cyclical position of the economy. The business press from time to time featured diametrically opposite interpretations of the battery of current economic indicators by eminent members of the economic fraternity. The custodians of business-cycle annals with some benefit of hindsight are now apparently prepared to enter mid-1960 as the turning point of the phase of expansion which began in April, 1958. But even as late as the year-end, some hardy business analysts still found the label of recession an inappropriate description of the economy's current position.

To have economists differ as to the prospective cyclical position is not at all unique—particularly in the early months of a year divisible by four. Such diversity is anticipated and understood by their audience. But it is unusual to have so much uncertainty surround the question as to where the economy is—this difficulty of diagnosis thereby compounding the more familiar difficulty of prognosis.

Viewed against this background, this examination of economic indicators for industry takes on far more timeliness, I suspect, than when the theme was first proposed. In current form the question at issue becomes this: Did the uncertainties surrounding the cyclical position of 1960 stem from inadequacy of information; if so, what specifically was lacking in the system of current economic intelligence? Or conversely, does the diversity of viewpoint represent difficulties of interpretation rather than lack of data?

In my judgment this disparity of viewpoint is more a product of the problems and difficulties of interpretation than it is of the paucity or inadequacy of data. That conclusion, however, is in no way meant as a blanket endorsement of the nation's system of current economic intelligence. Good as it is, it wasn't good enough in 1960 to help either the government or business analyst determine the true dimensions of steel inventories. Month after month such inventories were described as being on the verge of attrition, only to have production fall even further below the imputed rates of consumption. In this age of electronic wonders we should no longer have to estimate the state of consumer stocks of so vital a commodity as a residual—and that after a series of heroic assumptions about prevailing rates of steel consumption.

A second statistical blindspot as of late 1960 is the lack of knowledge about the course of personal saving. This is a hardy perennial rather than a new complaint. Data on personal saving are inadequate both as to

timing and content. Specifically, the saving done by noncorporate business should be separately listed, even if included, in the personal saving total. The liquid saving figures of the SEC appear too late to be of much usefulness in current business analysis and forecasting.

A third area of inadequacy is in new-order reporting. Many business analysts regard the new-order series as the best of the sensitive cyclical indicators yet developed. The complaint here is more on the timing than on content. Release of inventory, shipment, and new-order data four or five weeks after the month to which the figures apply is slow compared with the earlier availability of similar figures assembled by private services. The Conference Board has been giving thought to telegraphic reporting of such figures from a selected portion of its Associates. The processed results might then be made available within a fortnight after the month's close, or at about the same time that employment-production data are also being released.

My emphasis throughout the balance of this paper, however, is upon a schism that threatens to grow wider among the interpreters of economic data rather than upon the several glaring weaknesses in our reporting scheme. One group of analysts, by far the largest in number, continues to base its interpretation primarily upon the traditional corpus of historical data. This body of knowledge is comprised largely of data assembled over the years for manufacturing, mining, construction, and agriculture. It is from these industries, in the main, that our indicators of industrial activity are drawn. As the economy changes, we slowly eliminate or discount the value of some of the established series that are no longer so sensitive or broad a measure of industrial activity as previously. These are replaced or augmented by others; e.g., hours of work, or labor turnover. But on the whole, the indicators, particularly for the current position of the economy, are those relating almost exclusively to the primary and secondary industries.

A second group of analysts, in the minority, but growing in number also relies heavily in its analytical pursuits upon indicators for the primary and secondary industries. But, in addition, it gives steadily greater weight in its analysis of current position to trends in the tertiary or service industries and to the preponderantly service sectors of the national accounts.

This ever heavier emphasis upon the service industries is, I believe, thoroughly justified. Nearly 25 million individuals are now on payrolls in wholesale and retail trade, in financial institutions, and in the various personal service groups. In contrast, the comparable total for all of manufacturing, mining and construction is about 20 million. To the number on private payrolls in the service sector should also be added nine million nonfarm, self-employed workers and domestic servants, raising the

total in the tertiary group to 35 million. Finally, allowance for service workers on government payrolls, including the Armed Forces, would bring the grand total of service workers to 45 million.

The United States Bureau of Labor Statistics emphasized this shift in relative importance: "About 1950, for the first time in history, the number of workers in service industries surpassed the number in the production industries, and the differential has been widening ever since. By 1970, workers in service industries will account for 57 per cent of all workers." (See table 1.)

This swing toward the service sectors was also stressed in the report of Thomas J. Watson, Jr. on "Technological Change" to the President's Commission on National Goals: "Today almost half of the nonfarm labor force is employed in managerial, clerical or sales jobs. . . . Service industries, too, such as transportation, retailing, finance, utilities, and government service have undergone a major transformation. Until the late 1940's, there were always more people in production industries—manufacturing, agriculture, construction and mining—than in the service group. Now there are over 25 per cent more employees in the service than in the production industries, with an increase of over five million people in less than 10 years." ("Goals for Americans," The Report of the President's Commission on National Goals, 1960, p. 197.)

TABLE 1. TRENDS IN CIVILIAN EMPLOYMENT[a]

Year	Production Industries		Service Industries	
	Number (millions)	Per Cent	Number (millions)	Per cent
1930	22.1	56	17.4	44
1940	22.5	54	19.1	46
1950	25.7	49	26.5	51
1960	27.2	45	33.4	55
1970	31.1	43	41.9	57

Source: Supplementary Statistics for use with *Manpower Challenge of the 1960's*, U.S. Bureau of Labor Statistics, 1960, p. 12.
[a] Excludes domestic service and nonagricultural self-employed.

Because of shifts in the relative levels of value added, the increased relative importance of the tertiary industries as sources of employment is not reflected in a corresponding gain in their percentage contribution to national income. Their share of the national income is about the same as in 1929, although considerably larger than in 1947. Less income is contributed relatively by the finance and utility groups, but this has been more than matched by the growth of government payrolls. (See table 2.)

The income now orginating in government and trade combined is al-

most equal to that arising in manufacturing. (On the basis of income flows—i.e., including government interest and transfer payments—government and trade would account for fully a third of all income received by individuals, well over the corresponding share flowing from manufactures.) Even after the exclusion of government, the service industries contribute more to the national income than do the primary-secondary industries combined. In the aggregate, the public-private service sectors account for three-fifths of the entire national income and an even higher proportion of all income received by individuals.

TABLE 2. INCOME ORIGINATED BY MAJOR PRIMARY, SECONDARY, AND TERTIARY INDUSTRIES, 1929, 1947, 1959

Industry	1929		1947		1959	
	Billions of Dollars	Per Cent	Billions of Dollars	Per Cent	Billions of Dollars	Per Cent
Primary-Secondary	36.0	41.0	90.6	45.7	163.4	40.9
Agriculture	8.3	9.5	19.3	9.7	16.8	4.2
Mining	2.0	2.3	4.2	2.1	5.5	1.4
Contract Construction	3.8	4.3	8.4	4.2	21.7	5.4
Manufacturing	21.9	24.9	58.7	29.6	119.4	29.9
Tertiary	51.0	58.1	106.7	53.8	234.0	58.6
Wholesale-Retail Trade	13.4	15.3	37.3	18.8	66.9	16.7
Finance, Insurance, Real Estate	12.7	14.5	15.3	7.7	40.5	10.1
Communication, Public Utilities, Transportation	9.5	10.8	16.6	8.4	32.7	8.2
Services	10.3	11.7	18.9	9.5	45.1	11.3
Government	5.1	5.8	18.6	9.4	48.8	12.2
Total National Income	87.8	100.0	198.2	100.0	399.6	100.0

Source: "National Income Supplements" to *Survey of Current Business*, U.S. Dept. of Commerce.

So far as expenditures for services are concerned, these in the aggregate are far less cyclically responsive than are outlays for products of the primary-secondary group. The coefficient of income elasticity for service outlays of consumers is lower than for durables or nondurables. "During swings in the business cycle," the U.S. Department of Commerce has concluded from its examinations, "durable goods purchases in real terms have responded more intensely, nondurable goods rather moderately, and services have been fairly insensitive to income changes." (Louis J. Paradiso and Mabel A. Smith, "Consumer Purchasing and Income Patterns," Survey of Current Business, March 1959, p. 23.)

The dissident group to whom I referred earlier gives ever greater consideration in their analysis of current and prospective business conditions

to the built-in stabilizers of a service-oriented economy. Alexander Sachs, one of the first of such dissenters, has held, "We are inescapably led to the conclusion that the technique of cyclical indicators is far more fallible and far less reliable than the technique of sector analysis and evaluation of the elements and the forces that enter into the shape and control the gross national product." ("On Determination of the 1957 Outlook," *The Conference Board Business Record,* April 1957, p. 190.)

Most recently, Jules Backman voiced his discontent with the existing body of economic indicators: "I think we have become preoccupied with business indicators that have lost their former significance as indicators of trends for the entire economy. Those indexes have recorded sharp drops in some cases for explainable reasons. But the fact remains that if we are going to spend more money on education and vacations, as illustrations, we must count those expenditures as factors in our economy just as we do a decrease in carloadings. . . . We cannot use the old indicators as comprehensive measures of economic trends because they no longer reflect fully the goods and services that are being bought." ("The Business Outlook, 1961," *Studies in Business Economics,* No. 70, National Industrial Conference Board, 1960, pp. 82-83.)

Those charged with the custody of economic indicators have not been unmindful of this intensification of interest in service industries. More current data have been developed for them and for those national aggregates in which the stablizing influences of the expanded service components can be clearly seen. Witness the release of quarterly estimates of gross national product in current and constant dollars, the stratification quarterly of personal consumption expenditures by several major types of outlays and the monthly flash reports on retail trade. These are outstanding illustrations of a productive response to the need of the analyst for basic information on current developments in key accounts for the service sector.

Essentially, however, the monthly measures even in the revised *Economic Indicators* of November 1960 continue to be drawn from the historic mold of primary-secondary industries. The volatile indicators are given the greatest degree of prominence. End-product demand is still left to be computed by the sophisticated user of national accounts and remains unidentified for the lay user. Trade is given more space—a full page—in the revised *Indicators,* but few monthly measures are presented for other sectors of the giant service complex.

Such weekly measures as are featured in the business press or weekly summary releases are even more heavily concentrated on the course of production. One hardy entry weekly, department store sales, is stretched far beyond its steadily delimited sphere of significance to serve as an indicator of trends in retailing and consumption.

The latest readings of the battery of economic indicators, as currently constituted, undoubtedly help shape, if they do not determine, consumer and business anticipations. As currently constituted, these indicators—particularly the weekly and monthly measures—are drawn heavily from the primary-secondary industries, and especially the more sensitive components. These are no longer as significant of trends in the balance of the economy as they were prior to World War II. Failure to adjust the prevailing monthly or weekly system of economic intelligence to give warranted prominence to prevailing trends in the service industries not only renders the task of analysis more hazardous for the trained observer, but it can also adversely affect investment decisions and consumer buying plans.

Two suggestions are offered in the hope of bringing about a better balance in the array of economic indicators as well as in the impression conveyed by such measures to the general public. The first concerns further development of the gross national product accounts for purposes of current business analysis. These accounts are without question the most popular of all economic measures. They figured prominently in the recent debates of the presidential candidates. They are a common ingredient in discussions of economic growth here and abroad. The gross national product, for better or worse, is now the most widely accepted measure of aggregate national economic activity.

Valuable as was the development of quarterly estimates of gross national product, the potentials seem even more rewarding for the construction of such figures on a monthly basis. At the same time more body could be put on the skeletal framework of the quarterly accounts, as presently estimated, particularly for consumption expenditures. Quarterly data should come as close as possible to the detail on annual personal consumption expenditures in the National Income Supplement (Table II-4).

At critical or turning points in the business cycle, the need for a more broadly based battery or current indicators grows acute. As currently constituted, the prevailing indicators fail to provide the necessary balanced perspective. A case in point occurred shortly after Labor Day when a series of unfavorable reports emanated from the volatile primary-secondary industries. This was also the season in which capital budgets were being formulated. Undoubtedly business expectations were adversely influenced by the tenor of economic news at that time.

The strength of end-product demand and the sustaining influences then prevailing in the service sectors was not revealed until well into the fourth quarter. By that time the budgeting process had been completed, incorporating in some instances allowance for a more severe general business contraction than the actual situation justified. A similar overemphasis upon the areas of contraction may have again emerged from the

indicators available thus far for the fourth quarter. The desirable perspective provided via the gross national product measures will not be forthcoming for some weeks to come.

Innumerable and seemingly insurmountable difficulties are bound to arise in connection with the development of monthly measures of national product and national expenditures. Given more resources and the proper degree of sympathetic understanding, I believe the national social accountant would again rise to the challenge as in the case of quarterly estimates and that steady progress in this direction could be forthcoming.

The second suggestion is far more general than specific. It stems from the evidence previously offered as to the under-representation of the services industries in the indicators of current activity. Some years ago (1954), the Federal Reserve Board, at the suggestion of the Joint Economic Committee of the United States Congress appointed several Task Forces to investigate the adequacy of statistics for key areas. Full-scale reports were submitted by Committees on Savings Statistics, Consumer Expectations, Inventory Statistics, General Business Expectations, and Plant and Equipment Expenditure Expectations. These reports were not only of value in connection with improvements that could be and were readily incorporated, but even more in terms of proposed avenues of research that subsequently have been profitably explored. (These include such innovations as the Board's series on capital appropriations, financed by *Newsweek* and *Iron Age*, and the series on consumer buying plans, also financed by *Newsweek*.)

A similar series of task forces might well be set up now to deal with the obvious inadequacies currently prevailing for the service industries. Such a task force might outline, for example, how to modernize the indicators for consumption. Because of the postwar upheaval in the market place, better monthly data on consumption expenditures are an imperative for the Sixties. The aggregate retail sales figures issued monthly by the Department of Commerce provide a useful indicator, but only for the goods component of the personal consumption sector of national accounts. Particularly in point is the need for better identification of the particular categories of consumer items in demand, both goods and services. When grocery stores sold groceries, segmentation of retail figures by type of outlet provided reasonably accurate information concerning what the consumer was buying. But since the war, and particularly in recent years, there has been a vast reshuffling in the merchandise lines marketed by most "standard" types of outlets. Thus, sales figures for a specific type of store no longer accurately reflect the kind of goods being sold.

Personal consumption expenditures for food purchased for off-premise consumption increased by about 20 per cent over the past five years. In the same time span, food store sales advanced by a striking 30 per cent.

This is perhaps a rather rough indicator of the extent to which food stores have been expanding their nonfood departments. The comparison is not immaculate in method, but the sharp difference between the numbers does make the point. A similar change has spread over the entire spectrum of retailing—women's clothing stores sell items of men's apparel, drug stores sell small appliances, and so on all along the line. The growing promiscuity of merchandise mix seriously blunts the usefulness of "type of store" retail figures and underscores the need for developing estimates of retail activity by product class. In addition to exploring the possibilities of monthly estimates of retail trade by commodities, the task force might weigh the prospects for monthly data for such giant service industries as recreation, tourism, hotels and motels, hospital care, and insurance, to name but a few.

Still another burgeoning service area for which quarterly or monthly data would be particularly revealing is research and development expenditures. This form of business investment may be far better maintained over the cycle than its counterpart of brick and mortar. Through the work of the National Science Foundation a steadily more detailed statistical base has been built for this new industry of discovery. Along with the intensification of interest in research as a form of investment has come more detailed record-keeping, so that the proposed task force might well consider measures of both prospective as well as current outlays (e.g., research appropriations as well as outlays).

Another huge component of the service complex is advertising, which as in the case of research and development, gives steadily greater promise of moving countercyclically. Current reports for this $10 billion—or more—industry are confined largely to the trade's own journals, although more space and attention is now being devoted to its economic trends in the metropolitan press. Here again the outlays have grown so large that more specific records have now been set up by the largest advertisers and much more information is available in published corporate reports on the amount spent and by media. In addition to this current reporting phase the task force might explore the possibility of developing expectational data for this sector. Some efforts have been made by The Conference Board to develop a quarterly reporting system on advertising appropriations of the thousand largest national advertisers, similar in purpose to the series on capital appropriations of the thousand largest manufacturing enterprises. A modest pilot effort strongly suggests the foreshadowing significance of such a series, but efforts to secure financial support for more complete exploration have not been fruitful thus far.

As with the preceding reports of such task forces, where additional research is necessary or would be helpful to the implementation of monthly accounts, a research agenda could be developed and an order of priority

suggested. From this and related activities, including hearings of the Joint Economic Committee, could well be provided the necessary stimulus for the proliferation of indicators for the service area. Without these additions, current economic indicators are bound to grow increasingly inadequate for today's consumer-centered, service-oriented economy.

DISCUSSION: HOW WELL DO THE ECONOMIC INDICATORS INDICATE WHAT IS HAPPENING IN THE MAJOR SECTORS OF THE ECONOMY

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Perhaps I should start by sharing the sources on which these remarks are based, especially so since only one of the three main papers was available to me before today, December 30, 1960.

As preparation for what must necessarily be an extemporaneous discussion, I first reviewed the efforts of Geoffrey Moore and his associates at the National Bureau to select a handful of leading business cycle indicators, assuming our interests might chiefly center around a few selective indicators and their value rather than in the whole range of statistical measures relating to labor, business, and agriculture.

With this idea of selective indicators in mind, I next turned to that most useful monthly release, Economic Indicators. Instead of the dozen or so leading indicators which Geoffrey Moore works with, we here find that the Council is endeavoring to describe the current state of the American economy in 33 "systems" of indicators, each of which contains 6 to 12 statistical series (317 in all).

There was then the article by James S. Duesenberry, Otto Eckstein, and Gary Fromm, "A Simulation of the United States Economy in Recessions," which appears in *Econometrica* for October 1960. This I found to be a most interesting article, not so much because of the development of a series of structural equations as for the fact that the equations are solved in terms of real numbers in an effort to measure the relative effect or value of various "automatic stabilizers" designed to offset autonomous declines in the Gross National Product.

I also asked myself why farmers are so sensitive to farm price changes in view of the fact that agricultural economists so strongly insist that their real interest lies not in prices but in net income—that is, in volume of sales times prices less costs. The results of this effort are easily summarized. Using simple, straight-line regressions, I found that the percentage change in the index of prices received by farmers from one year to the next explained 89 percent of the percentage change in cash receipts from farm

marketings from one year to the next over the 25 years, 1935-60. And I found that the percentage change in farm prices explained 79.5 percent of the change in the realized net income of farm operators from farming.

Finally, due to the courtesy of the airline hostess on my way out, I was allowed to read an article on the "change seekers" in the latest issue of *Esquire*. As I understand this article, the "change seekers" are the bright young fellows whose knowledge covers not everything but rather how to get everything into the necessary equations and programs for automatic data processing in such fashion as to be able to discover the big, really significant changes which lie ahead.

It now appears, however, that my interest in selective economic indicators marks me as a manager or administrator; that the analysts and research directors are more interested in seeing that all the gaps are so filled in as to yield a comprehensive statistical system from which they can draw the appropriate "battery of indicators" relevant to any particular problem.

Boger's paper on agriculture starts with the statement that "We in the United States probably have the best agricultural statistics in the world" and then proceeds to discuss the extent to which this system of agricultural statistics is complete or where it could best be improved. It seems to me that Ruttenburg's paper is written in this same general setting. True, his discussion centers on corporate profits and unemployment statistics, since he feels the first is not current enough nor the second precise enough. But these are really special cases of places where he believes the over-all system might be improved and he in effect ends with two pleas having to do with Federal statistics generally, the first that the various Federal statistical agencies issue a combined directory of available statistical information and second, that Governmental agencies adopt a uniform method of introducing revisions, especially of monthly data.

I also understand that the paper which is on its way from Gainsbrugh turns chiefly on the argument that we pay too much attention to the traditional measures of performance in the primary producing and secondary processing industries, too little attention to the tertiary or service industries. This suggests the need for a systematic examination and improvement of statistics relating to the service industries which, as he indicates, are making an increasingly important contribution to the GNP.

I find myself in almost complete agreement with Boger's paper, including the need for more emphasis on improving our farm expenditure and cost data as well as the need for wider use of objective methods for determining acreage and yields for all major crops and classes of livestock.

Ruttenburg's suggestion that we need a current, fast-moving measure of corporate profits takes me back to the Duesenberry article, where the answers from the equations accord with Ruttenberg's desire. One of the lead-

ing conclusions is that "The reaction [to an initial shock] on consumption is likely to be small however, because of the automatic stabilizers. Of these, much the most important is the modern corporation, the profits of which suffer a large share of the decline in incomes, but which almost maintains its dividends." Ruttenburg's suggestion with respect to unemployment indicators will, I am sure, be discussed in detail by Ewan Clague.

I also expect to find myself in substantial agreement with the Gainsbrugh paper when it is received.

In conclusion, I am still somewhat worried by the feeling that there is no choice left for any of us but to use whole "batteries of indicators" regardless of whether we are looking at a particular sector of the economy—labor, business, or agriculture—or the whole of it. As a research adviser or analyst, I can understand this, but I still believe there is much to be said for an effort to evaluate the importance of a relatively small group of indicators about which we might try to educate the non-statisticians who in the end make most of our economic and political decisions. Whether we like it or not, some few of our statistical measures are leading indicators and we, as well as the non-statisticians, need to know more about their strengths and weaknesses. And I am even skeptical as to whether the "change seekers" will discover much from pouring masses of data into electronic computers unless and until they are able to sufficiently simplify the central or critical series to the point where they can contain and consider them in their own personal minds. Am I wrong?

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"The Work of the Business-Education Committee," by J. Cameron Thomson, Committee for Economic Development, December 1960, 9 p.

Regions, Resources, and Economic Growth, Harvey S. Perloff, Edgar S. Dunn, Jr., Eric E. Lampard, and Richard F. Muth. Baltimore: The Johns Hopkins Press, 1960. Pp. xxv, 716. $12.00.

This impressive study inquires into the principles governing the regional distribution of economic activity within the United States and associated differences in economic welfare. The objective is approached primarily by summarizing and analyzing interstate differences and shifts in a number of key variables, including population, industrial distribution of labor force, output of goods and services, extent of urbanization, per-capita income, labor productivity, and factor proportions. As befits a product of Resources for the Future, the performance is scholarly: a large mass of economic data is mastered; documentation is exhaustive; footnotes are meaty; and several hundred tables and charts are incorporated into the text and a statistical appendix.

While the book defies brief summary, a selection from its findings can demonstrate the range of issues considered. Essentially demographic factors—color and birth rate—turn out to be major explanatory variables not merely for the low-income problem in agriculture but also for much of the interstate deviation in per-capita incomes. Forces making for convergence in regional income patterns have evidently operated more strongly downward, as indicated by the experience of the Mountain States and the Far West, than those making for equalization upward. From this evidence, reinforced by the tendency for industrial production to remain heavily concentrated in the Northeast, the corollary is drawn that public policy does better to further factor mobility than to invest heavily within distressed areas, farm or nonfarm. Such decentralization of industry as has in fact occurred turns out to lack important agglomerative features characteristic of the older manufacturing belt, whose advantages have remained important for fabricating as contrasted with processing activities. At a time when the cult of "industrialization" is widely popular, attention is usefully called to a variety of growth patterns and sequences: advance in the Southeast by obtaining a larger share of slow-growth industries; the importance for Texas of a particular resource endowment in the form of petroleum and its geological associates; unbalanced development of transport equipment in the manufacturing structure of the Far West; and the pivotal role of tertiary activities in Florida.

The examination of interstate differences is considerably more satisfactory than the analysis according to "regions." A grouping into eight sets of contiguous states is somewhat better justified by data availability than by geographic logic and can hardly be equally relevant for the entire period since 1870 or for investigating different economic variables. Focus

on multistate regions rather than substate areas represents in part a division of labor with a companion study, Otis Dudley Duncan's *Metropolis and Region*. Some use is made of other regional designations for particular purposes—type-of-farming areas, steel "districts," state economic areas, standard metropolitan areas—and relations beyond the national border receive occasional mention. But the failure to treat alternative territorial groupings more systematically remains troublesome, since changing circumstances of "regions" variously defined have had an important bearing on public issues suggested by the book's title, including the formation of commercial policy, the rationale of federal administrative units, and the distribution of federal and state responsibilities.

Reflecting multiple authorship, some problems in combining monographic parts into an integrated volume remain unresolved. Chapter 6 provides an excellent statement of the principles governing the location of economic activity; Chapter 14 is a fine historical summary of "The Play of Technology on Resources"; and in Part V there is careful statistical treatment of factors affecting per-capita income. But the authors do not sufficiently reconcile possible explanations of regional income differences arising from two related but distinct sources: on the one hand, the inherent logic of industrial location, involving considerations of technology, market access, and resource availability; and on the other, more traditional analysis along the lines of relative factor prices and productivity.

Rare indeed is the economist who combines the historical learning, theoretical acumen, and statistical talent required for an intelligent appraisal of the book in its entirety. Rare also is he who cannot derive insight and stimulus from a careful reading of particular sections.

BORIS C. SWERLING

Food Research Institute
Stanford University

Farm Surpluses—U.S. Burden or World Asset?, Murray R. Benedict and Elizabeth K. Bauer. Berkeley: University of California Press, 1960. Pp. ii, 232. $3.25.

The authors of this book have asked an important and timely question, and although they have provided much information not readily available elsewhere, they have not answered the main question satisfactorily. Instead, they addressed themselves chiefly to a detailed description of the history of the volume and composition of U.S. agricultural exports, events which have influenced exports, and government export programs which have been important, especially in the past 20 years. This review of exports and programs is indispensable to discussion of the main question—the title of the book—and, in addition, will be exceptionally useful

both to students and to mature economists who are trying to shift their research or teaching interests from domestic to international problems.

Further, the discussions of production and trade problems of major farm commodities (Chapters 4 and 5), and of tariffs and international agreements, and capital formation and development in poorer countries (Chapters 6 and 7), are useful sketches for those preparing to interest themselves in the detailed literature of those matters.

It becomes apparent in the final chapter, entitled "Where Do We Go From Here?" that the authors consider our agricultural production capacity both a "U.S. burden and a world asset." One sees where their sympathies lie, but gets little indication of where they believe their analysis points.

It is encouraging to see that they recognize the difficulty of agricultural production adjustment in the U.S. through unaided market forces, the large adjustments that have already been made in cotton and wheat, and the need for a multiple approach, not only for the production problems of commodities with differing characteristics and grown under different conditions, but also for distribution to nations with widely different problems.

This is a useful and hopeful book, leaving open the possibility that the role of surplus commodity stocks as a burden can be diminished, and that there is some prospect of turning not only our stocks, but also our productive capacity to advantage in foreign policy.

JOHN A. SCHNITTKER

Kansas State University

The Changing Structure of the Meat Economy, Dale E. Butz and George L. Baker, Jr. Boston, Harvard Business School, Division of Research, 1960. Pp. xix, 204. $3.00.

This is the second in a series of fractionalized studies by the Harvard Business School showing the close relationships and interdependence among all segments of "agribusiness." As such, it is a descriptive analysis of past and present changes in the livestock and meat industry together with many rather bold statements regarding prospective changes. It represents a valuable addition to the literature as it brings a variety of pertinent data and materials together in one place and adds some further insights into the reasons for and mechanics of structural change. Industry leaders, producers particularly, and professional people in research and teaching who have not closely followed changes in the meat industry during recent years should find this book most interesting and useful. The study will have performed an outstanding service if it does nothing more than convince these and others that ". . . sweeping changes have occurred and will continue to occur in all segments of the livestock and meat economy."

"Structure" is defined broadly by the authors to include all conceivable horizontal and vertical relationships among firms in the meat economy. Accordingly, they describe trends in production, consumption, and slaughter; changes at each trade level in number, size and types of firms; changes in buying and selling practices; shifts in location of production, marketing and consumption; and changes in the bargaining power positions of the various industry segments.

An outstanding feature of the report is that it considers the entire livestock-meat industry. Separate chapters deal, in order, with consumption trends and patterns, retail buying practices, meat wholesaling, packing and processing, and shifts in the marketing of livestock. These chapters draw heavily from several previously published studies. An extensive bibliography and the appendix, containing 36 tables, also are useful source materials on changes in industry structure.

Two chapters, 7 and 8, deal with adjustments in livestock production and instability in the livestock and meat economy. These include discussions of adjustment alternatives facing producers, sources of income instability, and both private and public policy means of reducing such instability. Research and education, cooperation, contracts, integration, income payments, direct purchases and marketing orders are considered. Although the authors stress the importance of research and education and potentials for improvements through a "system of contracts" and cooperative livestock marketing, they see no immediate solutions to the problems of instability and low bargaining power in any of these proposals.

The Foreword states that the report is an ". . . attempt to select certain changes and then assess the impact of these changes on all segments or divisions of the industry." The principal criticism offered is that the book does not do this. Part of the fault lies in organization of the material. With separate chapters on each segment of the industry, the authors are led toward a simple descriptive restatement of changes taking place. Effects of changes in technology, marketing services such as grading and marketing information, and other factors are inadequately treated. Changes at the consumer level and in retailing are not carefully traced through for their effects on changes and needed adjustments at other levels.

The authors refer at several points to interviews with industry representatives and research specialists. No information is supplied, however, as to the nature or extent of these interviews. One gains the impression that these were casual inquiries designed principally to check interpretations of data and published materials.

The study is sprinkled with many statements and forecasts that these reviewers think the authors would have difficulty in defending. In some cases these seem to be the result of hasty preparation. Others, however, appear to be considered but poorly supported statements. For instance,

they expect concentration at all levels of the meat economy to increase despite evidence of a considerable decline in concentration at the packer level during recent years. Readers are not provided with bases for forecasts of shifts in the location and structure of production and marketing.

The authors, nevertheless, appear to be essentially correct in their conclusion that "The meat economy has been and will continue to be characterized by the everpresence of change in the organizaton of the industry, in its technology, and in the demands of the consumer." Ideas of consumers and retailers regarding quality in meat are changing. Even so, it no longer is enough simply to produce and market the "right" kinds of slaughter livestock. They must be produced and marketed in specialized minimum cost situations and locations and in sufficient volume, degree of regularity, and uniformity to attract the large volume specification buyers. Individual producers and firms, therefore, must adjust to these conditions if they are to survive, but those who adjust might realize little or no improvement in market power. In fact, the changes in prospect argue for less rather than more bargaining power on the part of producers and meat packers.

WILLARD F. WILLIAMS
JAMES MCDOWELL

Oklahoma State University

The Powerful Consumer, George Katona. New York: McGraw-Hill, 1960. Pp. ix, 275. $6.50.

Katona classifies his book as a contribution to psychological economics and states that "What psychological economics postulates is that changes in consumer attitudes and expectations are capable of influencing the proportion of income spent on discretionary purchases and sometimes, often at crucial times, do so" (p. 26).

Abundant use is made of the excellent empirical research which has been produced over the past fourteen years by the Survey Research Center at the University of Michigan, where Katona has been head of the Economic Behavior Program. Many of the readers of this *Journal* are familiar with the work of the Center—especially that done for the Federal Reserve System. However, this is not a rehash of past studies. The survey data are related to theoretical propositions.

The book contains 14 chapters, a brief appendix of comments on methodology in the study of economic behavior and six and one-half pages of bibliography. The chapter titles give a good indication of the content of the book. They are: Income and Confidence; Consumer Latitude; Consumer Attitudes and Demand for Durable Goods; The Nature of Attitudes and Expectations; On the Origin of Changes in Attitudes; Attitudes

and Behavior of Individuals; Stability of Consumer Saving; Motives and Levels of Aspiration; Rational Behavior; Group Belonging and Group Influence; The Psychology of Prosperity; The Psychology of Inflation; The Psychology of Recession; and Consumer Sanity.

In my opinion the book offers a promising general approach, some good research, and some contributions to economic understanding, but suffers from a lack of precision in definitions and rigor in analysis.

Katona argues that it is useful to consider both consumer expenditures and consumer savings as two classes—discretionary and other. The other consists of habitual, necessary and contractual expenditures or savings. It is the discretionary expenditures which have the important impact on the economy. Katona argues further that discretionary purchases are centered largely in durable goods. Purchases of non-durables, especially food, are considered to be largely non-discretionary and therefore unimportant as causal factors in the study of business fluctuations. The studies and arguments of the book deal almost exclusively with the purchase of durables and with savings. No evidence is given to justify the assumption that the non-durables are in fact not discretionary. Actually, individuals have a good deal of discretion in determining amounts spent for non-durables and exercise this discretion. And since non-durables constitute a much larger share of expenditures than durables, the absolute changes could be greater.

Katona goes on to argue that variation in consumer savings is not a significant factor influencing economic fluctuations. He anticipates the obvious question as follows: "it is a major thesis of this book that willingness to purchase durable goods may decline at a time of relatively high and stable incomes and usher in a recession. If this premise is accepted and if money not spent on durables is saved, would it not then follow that increased saving would be one of the precipitating causes of recession? The fallacy is, of course, that it is possible that income not spent on durable goods is not saved but rather spent on food, services and innumerable other small non-durable items. . . . The acceleration effect of durable goods spending, resulting from the fact that the production of durable goods requires many parts and machine tools, is reduced when the spending is for food and convenience goods."

This argument leaves me confused. What kinds of changes in attitudes would cause people, during a period of prosperity, to switch from durables to non-durables? If purchases of non-durables are non-discretionary, how come consumers *"decide"* to spend more on non-durables when they reduce durable purchases? How do we know that consumers didn't decide to increase non-durables purchases, leaving less money for durables? What evidence is there that a greater "acceleration effect" is related to durable purchases than to non-durables? While it is reasonable to hy-

pothesize that shifts in consumer expenditures will influence investment expenditures, the analysis presented is inadequate to support the conclusion. Considerably more study needs to be made of the relationship between consumer purchase behavior and the investment decisions of business. Perhaps the most important factor is what businessmen believe consumers are going to buy. In this respect predictions of consumer behavior made by the Survey Research Center and others may enter the picture as an important variable.

The general impression left from the book is that changes in consumer attitudes are potentially a powerful factor contributing to changes in economic activity, but that in recent years consumer behavior has had a stabilizing effect on the economy. We are also assured that the consumer, while not always well informed, tends to behave in a fairly intelligent manner.

This book is not easy to evaluate. Serious students of consumer behavior and economic fluctuations will find much useful information, stimulating ideas—and a good deal to criticize.

JAMES D. SHAFFER

Michigan State University

Statistical Cost Analysis, J. Johnston. New York: McGraw-Hill, 1960. Pp. ix, 197. $6.75.

In this book Professor Johnston analyzes the nature of cost-output relationships in six selected industries (electricity generation, road passenger transport, multiple product food processing, coal mining, building societies and life insurance companies). In addition, he considers the problem of measuring labor productivity in relation to size of establishment. He relies on accounting costs and other secondary sources for data. A variety of statistical techniques, including graphics, regression and correlation analysis, and analysis of variance, are utilized to test various theoretical hypotheses about short and long-run cost-output relationships. On the basis of his own analysis and those of 31 other statistical cost studies which he summarizes in the book, he gains two major, but unremarkable, impressions: ". . . The first is that various short-run studies more often than not indicate constant marginal cost and declining average cost as the pattern that best seems to describe the data that have been analyzed. The second is the preponderance of the L-shaped pattern of long-run average cost that emerges so frequently from the various long-run analyses" (p. 168).

Throughout the book, the emphasis is on the determination of the "shape" of the cost function while the level of costs remains a secondary consideration. With regard to short-run cost-output relationships, the author postulates four main hypotheses, the first three of which yield cubic,

quadratic and linear total cost functions respectively, and the fourth, derived from linear programming theory, yields a total cost function made up of linear segments. Long-run costs are hypothesized to vary according to the law of increasing and diminishing returns.

A careful econometrician, Professor Johnston seems to leave no stone unturned as he builds the bridge that links economic decision and cost theory to statistical theory. When he applies least squares regression techniques to the cost functions (as he does in three of the industries studied), therefore, he appears to be on reasonably solid ground either for a priori reasons or through the appropriate transformation of variables to meet valid least squares requirements.

The results of the analyses, particularly those involving the application of least squares technique would gratify most economists. Since space does not permit an evaluation of each of the studies included, the analysis of the short-run costs of electricity generation is offered as an example. The dependent variable (Y) represents total working costs of generation, which include fuel, salaries and wages, and repairs and maintenance. These costs are derived from annual data of individual firms and adjusted for factor price variations by appropriate indexes. For the independent variables he uses annual kilowatt output (X) and time in years (T). T is retained only if the t-test shows its regression coefficient to be significantly different from zero at the five percent level. Additional terms in X^2 and/or X^3 are added if there appears to be any curvilinearity in the scatter. They are retained only if the coefficients differ significantly from zero. In this particular analysis, short-run cost functions for seventeen firms are developed; twelve contain only a linear term in output X, and of these, seven contain a significant term in T; five firms have a quadratic total variable cost function, and four of these have signicant terms in T as well. The coefficients of determination for the seventeen functions average 94.1 percent, an indication that the independent variable(s) chosen explain a very high proportion indeed of the variance in Y. Professor Johnston seems disinclined to put much faith in the quadratic functions (primarily because of negative signs in the X^2 term) and concludes that "...the short period results tend to support the thesis of a linear total cost function with constant AVC and MC functions"[1] (p. 57).

The preponderance of linear functions which "fit" the data extremely

[1] All of the short-run functions had positive intercepts. Inasmuch as Y represents only working costs and not total costs, one might wish to argue that AVC was in fact declining. Professor Johnston suggests, however, that working costs "... probably include some elements of fixed costs; for example a certain amount of fuel is required to keep the plant banked ready for operations ..." (p. 47). He does not substantiate this assertion and thus leaves some doubt in the reader's mind as to the validity of his interpretation of AVC.

well seems to strike another blow at the widely held concept of increasing marginal costs. Many valid explanations of constant marginal costs can be given. The question at issue here is whether the author is warranted in drawing this conclusion on the basis of his study. A shadow of doubt creeps in when one realizes that Professor Johnston has paid little attention to the rate and time dimensions problem inherent in cost analysis. Working as he was with accounting cost data, this may have been impossible. None the less, he assumes that output differences between periods (in this case years) arise solely out of changes in the rate of output. This assumption could be valid, but my own experiences with cost analysis lead me to question it. When we think of rate of output we should properly consider it in an instantaneous sense. For convenience it is often stated in terms of output per hour. Then in some extended period—say a week or a year—one way in which output could be varied would be to operate at some constant rate per hour and to vary the number of hours worked. If the rate of output is constant and total output for the period is varied by varying the number of hours of operation we should not be surprised if constant marginal costs result, even if the cost function is curvilinear in the rate dimension. If, for example, at some specified rate of output (X), total variable costs were \$10.00 per hour, output in ten hours would be $10X$ and TVC \$100.00; in 100 hours output would be $100X$ and TVC \$1,000.00; and so on. In this case, costs and output are both linear functions of hours worked and, therefore, linear functions of each other. Engineering economic studies of costs suggest that many firms affect output variation primarily by varying the number of hours worked.

Of course, output could be varied by variations in both the rate and time dimensions. If costs in the rate dimension are in fact curvilinear, and increases in output in a period result primarily from increases in the instantaneous rate, total costs would tend to be curvilinear. Only when this is true would statistical analysis of accounting costs lead to quadratic or cubic functions. Since variations in output over time need not derive from variations in the rate dimension, however, we cannot be sure on the basis of Professor Johnston's analysis that curvilinearity in a rate sense does not exist—it well might.

The above discussion raises some interesting questions in regard to the selection of methods to be used in cost analysis. It seems to me the major consideration is the intended use of the results. If one is simply interested in describing how costs vary with output over a period, the approach outlined in this book may be appropriate. On the other hand, if one wishes to develop functions that are operationally meaningful—those that can be used as a norm in a profit maximizing context—statisti-

cal analysis of accounting costs will be of limited value. Other techniques, centered around the engineering-economic approach, can be more fruitfully employed for this purpose.

In closing, I would like to point out that within the limitations imposed by his data, Professor Johnston does a workman-like job in this book. He is obviously a competent econometrician who manipulates his tools very well. The careful reader who has an appreciation of econometric techniques can learn something from him.

FRANK J. SMITH, JR.

University of Minnesota

La Reforma Agraria de la America Latina en Washington, Lucio Mendieta y Nuñez. Mexico, D.F.: Instituto de Investigaciones Sociales, Universidad Nacional Autonoma de Mexico, 1960. Pp. 124. 15 pesos.

Latin American Land Reform in Washington is a manifesto on the most urgent, the most explosive problem in the southern hemisphere: the maldistribution of land. Motivated by an intrepid sense of social justice, Professor Mendieta y Nuñez strikes out against political conservatism and lack of political foresight, on behalf of the underpriveleged millions in South America's rural communities. His warning of chaos to come has the strength of the trumpets of Jericho.

Mendieta y Nuñez's discussion turns around a series of meetings held in Washington, under the auspices of the O.A.S., in the Fall and Spring of 1959-60, which were called in order to prepare plans for the financing of agrarian reforms in South America. At the conclusion of the meetings, a list of recommendations was adopted by the majority of the "experts" attending and it is these recommendations and the manner of arriving at them which the author criticizes.[1]

His thesis is as simple as it is forceful: Given the fundamental changes on the political horizon during the last few years, land reform cannot be postponed any more in South America. Even the lack of accurate statistical information cannot obscure a picture of great social and economic inequities. Land reform "*must begin with the redistribution of land*" (p. 19) through the expropriation of large estates, preferably in association with a scheme for compensating the expropriated "farmers." The governments of the Latin American nations either ignore land reform altogether or fail to attack its central issue, while the United States exhibits an ambivalent attitude by pointing earnestly on one side to the unequal distribution of property while preventing at the same time a serious consideration of the need for expropriation and the means of its imple-

[1] The author notes that the special committee was in effect not composed of experts as had been provided in the resolution setting up the committee, but of political representatives of the countries. Many nations were not represented at all.

mentation. Mendieta y Nuñez discusses in some detail a plan for the establishment and the functioning of an Interamerican Land Bank and deplores that this plan is being considered untimely because Latin American nations are not yet "ripe" to attack in common the problem of financing land reform.

These views stand in sharp contrast to those expressed in the majority recommendations. Thus Mendieta y Nuñez's booklet becomes a political diatribe, and few patriotic citizens will relish the harsh things which he has to say:

> The representative of the U.S. in the [Special Commission of Experts for Financing Land Reform] approved nothing which could imply the expropriation of land because he was thinking of the enormous "latifundios" operated in Latin America by firms or private individuals of his country. Nor did he approve the creation of an Interamerican Land Bank because he understood that an agency of this type would represent a constant invitation for the people of Latin America to undertake or accelerate their respective land reform programs, and would henceforth signify a threat to the territorial interests of U.S. citizens, and would endanger the relations of the U.S. government with the governments of the Latin American nations. . . .
>
> But with this policy, the U.S. prepare their own ruin. If they do not auspicate, if they do not collaborate in a gigantic interamerican effort to solve the agricultural problem of the Latin American nations effectively and in the shortest possible time, it will not be difficult to predict the future of that great country by examining the lessons of recent history and the economic and social realities of the Latin American countries. . . .
>
> However, in effect, our proposal, or any other proposal which would strive honestly and effectively towards the improvement of the rural proletariat of South America, is condemned to failure, because, while it is certain that . . . the changes which are occurring at the present time in the world, seem to lead humanity toward a definite measure of peace and justice, those changes begin almost always with generous projects; but they are not carried through peacefully. History shows that the oligarchies (including rural oligarchies) have never given up any of their privileges in the interest of the common good, of justice or of reason. It is necessary to snatch them from them with blood and fire. For these reasons, unfortunately, notwithstanding all the good words seeded into the winds, what one can see in the future of Latin America is a horizon in flames (excerpts from pp. 107-11).

Mendieta y Nuñez's manifesto comes at a time when we are desperately trying to evaluate the changes which are occurring in Latin America and to prevent in other parts of the southern hemisphere the "alienation of affection" which we have witnessed in Cuba. At the recent interamerican conference in Bogotá in September 1960, Douglas Dillon used dramatic words echoing our deep concern over the dangers inherent in social and economic injustices and he submitted the text of an agreement (the "Bogotá Act") which provides specifically for social programs to eradicate those injustices of which he had spoken in such fervent terms. The list of programs is headed by agrarian reform and, though a close study of the

Act seems to confirm Mendieta y Nuñez's complaint that the crucial issue of agrarian reform—the expropriation of large estates—is being by-passed, the recognition of the urgency of land reform in such high circles, though belated, is a hopeful development. But is it enough?

No one needs to agree with the author's central proposition that land reform "must begin with a redistribution of land" through expropriation, but even those who disagree will have to admit that his essay is an important piece of literature. Professor Lucio Mendieta y Nuñez is one of Mexico's and Latin America's most distinguished social scientists. His government experience and academic contributions make him an authority on agrarian problems. Even when one discounts the fact that due to their historic experiences Mexicans are sometimes touchy when it comes to the question of agrarian reform, Mendieta y Nuñez's voice is apparently that of many Latin Americans who are genuinely striving for economic and social progress through orderly, peaceful, democratic processes, while being under no illusion with respect to the political difficulties facing a peaceful, democratic implementation. What is more: he shares with them the view that a redistribution of large estates should entail the owner-operatorship of smaller farms in the image of the agriculture which has been developed in the industrialized nations of the west. For these and other reasons, it is hoped that his essay will be translated and published in this country at an early date to acquaint the American public with what appears to be a representative view of Latin American liberals.

ERNEST FEDER

University of Nebraska

Seeds That Grew, A History of the Cooperative Grange League Federation Exchange. Joseph G. Knapp. Hinsdale, N. Y.: Anderson House, 1960. Pp. xvi, 535. $6.50.

This is the story of the way a few driving spirits developed an organization in which some 117,000 New York, Pennsylvania, and New Jersey farmers in 1958-59 had an average investment of about $600 each, and which did about a third of a billion dollar volume of business for them.

The 48 chapters are grouped into five parts: I. The Rise of the G.L.F., 1900-20; II. Establishing the Idea, 1920-30; III. Developing the Enterprise, 1930-40; IV. Strengthening the Structure, 1940-50; V. Redesigning for Growth, 1950-60. There are some thirty illustrations, mostly photographs of participants, and eighteen charts for visualizing the nature of the organization and its geographical spread in New York, Pennsylvania, and New Jersey.

This book represents a lot of work. The author has painstakingly traced the growth of G.L.F. by assembling and piecing together a vast array of bits of well-documented information. His sources include

mainly internal correspondence and memoranda plus writings by and interviews and correspondence with leading characters in the history. He has made it a "live story" by carrying the developments along with the ideas and philosophies of the men whose drives made the organization grow in spite of an incredible number of mistaken approaches, unexpected turns of events, constant attack by competitors, and apathy on the part of many farmers.

This book is not for the casual reader. He would feel like the school girl who reviewed a book on Penguins: "The book told me a great deal more about Penguins than I really cared to know." But for those who are interested in large-scale cooperation as a means of improving the efficiency of the individual farm, it is well worth reading. It should be particularly sobering to those who are filled with enthusiasm for current ideas on "integration" or other large-scale approaches to self-help.

At numerous places the discussion of events includes the reasons why one or another kind of action was proposed, sometimes on issues long controversial in cooperative circles. One such is the decision to give up tax exemption status (pp. 329-335). Another is the decision to cut prices of feeds to members instead of waiting to pay a year-end patronage dividend (pp. 394-397).

The reviewer has the feeling that some of the unsuccessful ventures were "soft pedaled." A case in point is the reporting of the canneries experience (pp. 321-327). This apparently proved to be a disastrous approach to "integration," yet one which the author treats gingerly. A frank and fuller treatment might be invaluable to others who are considering similar undertakings.

For the factual minded there are a series of five appendices. These are: A, Certificate of Incorporation and By-Laws; B, Past and Present Directors; C, Price Movements, 1920-59 (indices of prices farmers received and paid); D, G.L.F. Operating Statistics, mostly 1924-25 to 1958-59 (some two dozen columns); and E, Financial Statements for 1957, 1958, 1959.

H. E. ERDMAN

University of California

The Separation of the Farm Bureau and the Extension Service; Political Issue in a Federal System, William J. Block. Urbana: University of Illinois Press, 1960. Pp. vii, 304. Paperbound, $4.00; clothbound, $5.00.

Agricultural economists in general and those studying agricultural policy in particular are constantly being aided or hindered by the workings of the political system within which they operate. Many tend to disregard this system, or treat it as some constant value which has no effect on their recommendations or conclusions.

Mr. Block, in this book, points out that the political maneuvering tool in agriculture is as important and effective as in any other area of national interest. The long and sometimes bitter struggle resulting from the parallel development of the Extension Service and the Farm Bureau, presented in this book, is an example of such a political issue.

Beginning with the Act of 1862, which established the United States Department of Agriculture, and the legislation which followed establishing land-grant colleges, providing federal funds for research in the states and the establishment of a program of rural adult education, the author traces the Topsy-like growth of the Extension Service and the Farm Bureau. This was made easier and more accurate through the author's access to the personal correspondence files of prominent educators, administrators, and politicians aligned on both sides of the struggle for separation of the Farm Bureau and the Extension Services that followed this parallel development.

Although the fight was fought in the political arena, the issues behind this fight were primarily economic. The American Farm Bureau Federation and the National Farmers' Union as well as the National Grange were competing for members and for sales in their various cooperative enterprises and this provided a great deal of stimulation to the separation issue.

Federal aid to agriculture in the form of credit facilities, price-support programs, and soil conservation programs were the issues that served as a backdrop for the fight. This is carefully pointed out by the author. It is further noted that the struggle was nonpartisan, the farm organizations aligning with economic policies for agriculture rather than with political parties. This gives further credence to the suggestion that economic issues were primarily responsible for the fight.

Since this book was adapted from a doctoral dissertation, it is organized as a scientific, objective study of the conflict. It opens with the presentation of three hypotheses to be tested by the study, namely: (1) that the intensity of activity about such an issue is greatest when formal organizations are in direct competition, as for members, sales and government aid; (2) that formal arrangements between a private association and a governmental agency will be defended not only by participants under direct attack, but also by those who are interested in the more general goals of either organizational partner to the arrangement; and (3) that formal organizations, even though apparently unified about an issue, are not monolithic, and that in such a controversy as this, the effective groups will include members from formal organizations which are officially ranged with the opposition.

By a chronological examination of the political activity surrounding the struggle to separate the federal-state supported agricultural extension

program and the privately supported American Farm Bureau Federation, the author proceeds to qualitatively test these hypotheses about political processes. As the battle progessed, the anti-separation group slowly lost ground to the separationists until, with the issuance of Memorandum 1368 by Secretary of Agriculture Benson in 1954, the final blow was struck. This memorandum prohibited any Department of Agriculture employee from receiving compensation from any farm organization. Most interestingly, the author shows that opposition to this order came mostly from persons connected with the state universities. These people opposed the order, not because of pro Farm Bureau feelings per se, but because removal of Farm Bureau support would cause a "pinch" for funds and thereby hamper extension efforts where Farm Bureau contributions were sizable. This was true, however, in only a limited number of states.

In the summary chapter, the author rejects as false the second hypothesis and could not reject the first and third hypotheses. These are qualitative tests and are not accompanied by probability statements. However, the use of this sort of scientific form of study maintains the focus of the analysis throughout the book.

This work is well documented, if not too detailed in certain portions. In the reviewer's opinion, it is a notable contribution to the area of agricultural history and politics, both of which bear on past, current, and future problems faced by agricultural economists. In addition, it is a well-organized portrayal of one segment of the American political process.

JOSEPH C. HEADLEY

University of Illinois

Agricultural Finance (Fourth Edition), William G. Murray and Aaron G. Nelson. Ames: The Iowa State University Press, 1960. Pp. x, 486. $6.50.

Although the general outline and chapter headings of this fourth edition are essentially the same as in the third edition, the text has been revised more extensively than in any other edition since the first in 1941. The revised edition is particularly timely in view of the re-emerging importance of credit and capital problems in American agriculture for the first time in two decades. The book has been improved greatly by the last revision and is an excellent undergraduate text on agricultural credit principles and agricultural credit institutions. However, the title "Agricultural Finance," remains a misnomer. Agricultural finance encompasses a much broader area than agricultural credit and credit institutions. It includes capital accumulation, capital acquisition and control, estate planning, insurance programming, tax management, and other related phases.

The text is divided into two nearly equal parts—principles of agricultural finance and analysis of lending institutions. Part I on principles has been strengthened materially by the addition of chapters on acquiring

capital to farm, returns and repayment capactiy as a guide in use of credit, risk-bearing ability, and lender's analysis and servicing loans. The new chapter on repayment capacity begins to distinguish between the operating capital needs (repayable from gross income) and the capital requirements of the physical plant (repayable from net income). As total capital requirements per farm and cash operating expenses relative to gross farm sales continue to rise, credit principles and procedures applicable to these two types of loans differ significantly. Likewise, balance sheet analysis may serve as a sufficient guide during periods of inflation such as the past two decades. However, income potential and repayment capacity are much more adequate guides for periods without inflation.

Part II—Analysis of Lending Agencies—describes the relative importance and operational procedures of the many private, cooperative, quasi-government, and government agencies providing credit to farmers. No attempt is made to analyze the quality of performance by the various lenders. All materials in this part have been reorganized and brought up to date. The treatment of commercial banks, particularly their relationship to the Federal Reserve System, has been expanded. The treatment of insurance companies is more complete. Chapters on the agencies of the Farm Credit Administration have been almost totally rewritten in view of the organizational changes since 1953. The only large factor in the farm credit market not treated separately is loans made by individuals to farmers. These loans loom large in the total agricultural credit picture, particularly the farm mortgage sector, where individuals hold nearly one-half the total loans outstanding.

Essentially no benchmarks are established with respect to the amount of credit a commercial farmer might use for operating purposes or for purchases of land, buildings, machinery, and other capital items to produce a given gross income.

This book is an excellent textbook for an undergraduate course in credit and lending institutions. It could also be used for the credit and lending aspects in an agricultural finance course, but it touches too lightly on some of the important aspects of financial management in agriculture for use as an agricultural finance textbook. Even so, the reviewer recognizes that no text is available to cover all phases of agricultural finance. Where a text is used, this book remains the best available.

HOWARD G. DIESSLIN

Farm Foundation

Linear Programming and the Theory of the Firm, Kenneth E. Boulding and W. Allen Spivey. New York: The Macmillan Company, 1960. Pp. viii, 227. $6.00.

One does not often find the combination of rigorous and basic mathematical approaches and broad social concepts in a volume focused

toward an understanding of the firm. Such an approach is found in the contributions to a symposium arising out of a seminar for college teachers of economics in small colleges, sponsored by the Ford Foundation in the summer of 1958. The contributions examine the techniques of linear programming and operations research as well as developments in organization, cybernetics and information theory. In terms of space, major emphasis is given to the mathematical basis of linear programming and a comparison of marginal analysis and programming. In addition to an introduction by Boulding, discussions of operations research, the multiple goals in the theory of the firm and a managerial theory of the firm are presented.

Boulding, in his introductory chapter, argues for the need of extending the classical theory of the firm, useful for the small firm under the conditions of timelessness, perfect knowledge, etc., to a useful theory for large firms where matters of organization, politics, and social responsibility are large and visible. He suggests that this extension is not a revolution in the theory of the firm as much as it is a deepening and broadening of the understanding of the complex systems of human behavior. He recognizes that utility maximization is a method of handling these types of problems in a marginal analysis framework, but contends that organization theory, information theory and cybernetics may give meaning and structure to the concept of utility maximization. He also points out the value of operations research as the basic data and goals may be more accessible from the usual information system. Their value in decision-making where there are other goals besides profit maximization, or where the problems concern less than the whole enterprise, is pointed out in a later chapter, by Jenny.

A perceptive, persevering student with only a background in algebra and geometry probably could emerge with an understanding of the mathematics and theory of linear programming from the chapters, "Basic Mathematical Concepts," and "An Introduction to Linear Programming," by Spivey. The chapter on the comparison of marginal analysis and mathematical programming, by Wu and Kwang, is also understandable by the mathematically unsophisticated student. Although the above material constitutes the major portion of the book in regard to space, it contains relatively few items of interest to the agricultural economist who has familiarity with linear programming techniques. He may find considerable challenge and stimulation in the other portions of the volume.

In chapters dealing with multiple goals, by White, and a managerial theory of the firm, by Cleland, concepts largely developed outside the field of economics are applied to the analysis of the firm. These include: "Homeostasis," the maintenance of some "state" of the system (firm) in the face of changes in its environment; and "noise," change or distortion of the information input. Emphasis is placed on the role of information

and the use of information by the manager in meeting the multiple goals of the firm. To summarize, "the traditional theory of the firm considered the firm as a passive reactor to market events, intent upon maximizing profits. The managerial theory of the firm considers the firm as an organized information system, intent upon a satisfactory profit level operating in an external and internal environment which allows the manager significant decision-making power" (pp. 215-16).

The volume does not present a completed reconstruction of the theory of the firm. It is more a series of rough sketches of the paths which may be followed in the development of a unified, useful theory of the firm. The question of the relevance of such a theory for agricultural economics remains. Marketing researchers might find it useful, as many of the firms studied are large and somewhat able to influence their environment. Researchers dealing with the farm firm may find more limited use for such a theory. Problems of decision-making under uncertainty provide a fertile field for the theory. In fact, farm management researchers might well play a major role in its development and testing.

R. J. HILDRETH

Texas Agricultural Experiment Station

PH.D. DEGREES CONFERRED IN AGRICULTURAL ECONOMICS, 1960

RICHARD S. ABLIN, A.B. University of Chicago 1950; A.M. University of Chicago 1953; Ph.D. University of Chicago 1960, Missallocation of Electric Power in the Pacific Northwest.

GERALD EDWARD ACKERMAN, B.S. Cornell University 1954; M.S.A. Ontario Agricultural College 1955; Ph.D. Purdue University 1960, Changes in Productivity of Farm Resources in a Central Indiana Area.

MAHESH CHANDRA AGARWAL, B.Sc. Agra University (India) 1946; M.Sc. Agra University 1948; Ph.D. University of California 1960, Rotation Selection on the Family Farm in the District of Muzaffarnagar of India.

JOHN MAX AMOS, B.S. Kansas State University 1956; M.S. Kansas State University 1957; Ph.D. Ohio State University 1960, An Economic Analysis of Highway Improvements on Country Elevators.

ROBERT CHAUNCY ANGUS, B.S. Cornell University 1950; M.S. Pennsylvania State University 1954; Ph.D. Pennsylvania State University 1960, Changes in Efficiency of Marketing Milk in Philadelphia and Pittsburgh, 1940 to 1957.

DAVID LEE ARMSTRONG, B.S. Ohio State University 1957; M.S. Ohio State University 1958; Ph.D. Ohio State University 1960; Development of Optimum Forage-Handling Systems in One- and Two-Man Dairy Farms in Western Ohio.

MOHAMED IBRAHIM BADR, B.S. Foual I Univ. (Egypt) 1941; M. S. University of Wisconsin 1957; Ph.D. University of Wisconsin 1960, Developing Statistical Methods and Systems of the Agricultural Sector in Egypt As A Part of Planning for General Economic Development.

GEORGE LOWELL BAKER, B.S. Purdue University 1953; M.S. Purdue University 1957; Ph.D. Purdue University 1960, The Structure of the U.S. Meat Industry.

RANDOLPH BARKER, B.S. Cornell University 1953; M.S. Oregon State College 1957; Ph.D. Iowa State University 1960, The Response of Milk Production to Price: A Regional Analysis.

ALFRED LOWELL BARR, B.S. West Virginia University 1955; M.S. University of Kentucky 1957; Ph.D. Oklahoma State University 1960, Dynamic and Static Analyses of Cattle Systems and Range Improvement Practices, Northeastern Oklahoma.

H. WALTER BAUMGARTNER, Agr. Degree Universtiy of Giessen, Germany, 1948; M.A. McGill University, Canada, 1956; Ph.D. University of Minnesota 1960, Factors Associated with Potential Mobility Among Farmers.

ROBERT P. BENTZ, B.S. Southern Methodist University 1953, B.S. Texas Technological College 1957; M.S. Cornell University 1958; Ph.D. Louisiana State University 1960, Effects of Packaging on Retail Egg Sales and Quality Deterioration.

ROBERT JACKSON BEVINS, B.S. University of Tennessee 1949; M.S. University of Tennessee 1955; Ph.D. Michigan State University 1960, A Measurement of Agriculture's Public Investment in the Education of 1940 Decade Farm-Nonfarm Migrants.

ALAN ROSS BIRD, B. Agr. Sc. (Hons) University of Queensland 1952; M.S. University of Nottingham 1957; Ph.D. Michigan State University 1960,

Toward a Feasible Program to Alleviate the United States Agricultural Surplus and Income Problem.

MELVIN GEORGE BLASE, B.S. University of Missouri 1955; M.S. University of Missouri 1956; Ph.D. Iowa State University 1960, Soil Erosion Control in Western Iowa: Problems and Progress.

CURTIS HOOVER BRASCHLER, B.S. University of Missouri 1950; M.S. University of Missouri 1958; Ph.D. Purdue University 1960, An Investigation of the Effects of Varying Rates of Inflation and Deflation on Agricultural Prices and Incomes.

DURWARD BREWER, B.S. Oklahoma State University 1952; M.S. Oklahoma State University 1954; Ph.D. University of Missouri 1960, An Analysis of Livestock Marketing Patterns in Missouri.

CARROLL GRANT BRUNTHAVER, JR., B.S. Ohio State University 1954; M.S. Ohio State University 1958; Ph.D. Ohio State University 1960, A Study of the Ohio Lamb Marketing Structure, With Particular Emphasis on Competitive Bidding versus Negotiated Pricing Systems.

ALFRED JOSEPH BURNS, B.S. Louisiana State University 1954; M.S. Louisiana State University 1956; Ph.D. Purdue University 1960, Factors Affecting Consumer Behavior in Food Shopping.

DAVID LINCOLN CALL, B.S. Cornell University 1954; M.S. Cornell University 1958; Ph.D. Cornell University 1960, Interregional Competition in the Production and Processing of Table Beets.

ALI MOHAMMAD CHAUDHRY, B.S. University of the Punjab (Lyallpur, West Pakistan) 1953; M.S. University of the Punjab 1955; Ph.D. Ohio State University 1960, The Use of a Farm Management Approach in Solving Agricultural Problems in Pakistan.

CLEVELAND ALDRIDGE CHRISTOPHE, B.S. Agricultural, Mechanical and Normal College (Arkansas) 1935; M.A. Atlanta University 1940; M.Ed. University of Arkansas 1957; Ph.D., South Dakota State College 1960, The Cost of Manufacturing Butter and Non-Fat Milk Solids in Two Model Plants in South Dakota.

WAYNE WALTER CLARK, B.A. Brigham Young University 1952; Ph.D. Texas Agricultural and Mechanical College 1960, Marketing East Texas Fruits and Vegetables.

LINDON UHLE COCKROFT, B.S. Ohio State University 1950; M.S. Ohio State University 1955; Ph.D. North Carolina State College 1960, A Systems Analysis of the Harvesting, Curing and Marketing Stages of Flue-Cured Tobacco Production.

WILLIAM HOWARD CONKLE, B.S. West Virginia University 1938; M.S. West Virginia University 1939; Ph.D. Cornell University 1960, The Status of and Trends in Produce Prepackaging in the Northeast.

CHARLES L. CRAMER, B.S. University of Missouri 1950; M.S. University of Missouri 1954; Ph.D. University of Missouri 1960, An Analysis of Changes In Structure of Hog Markets In Northeast Missouri.

BILLIE MACK CROSSWHITE, B.S. Berea College 1953; M.S. Michigan State University 1957; Ph.D. Michigan State University 1960, Optimum Enterprise Organization for Southern Michigan Specialized Dairy Farms.

CLARENCE FLOYD DAVAN, JR., B.S. Purdue University 1952; M.S. Purdue University 1953; Ph.D. Purdue University 1960, Effects of Direct Payments for Beef Cattle as a Program to Improve Farm Income.

JACK RICHARD DAVIDSON, B.S. University of Wyoming 1953; M.S. Montana

State College 1955; Ph.D. University of California 1960, Economic Efficiency and Firm Adjustment for Market Milk Production in the Southern Metropolitan Milkshed of California.

GILBERT DEMENTIS, B.S. Purdue University 1949; A.M. University of Chicago 1953; Ph.D. University of Chicago 1960, Resource Allocation in the Lower Rio Grande River Valley (1940-1956).

DHIRAJLAL KESHAVLAL DESAI, B.S. University of Bombay 1949; M.S. University of Poona 1959; Ph.D. University of Illinois 1960, Increasing Income and Production in Indian Farming: Possibilities with the Existing Resource Supplies on Individual Farms.

CLARENCE DUARD EDMOND, B.S. Oklahoma State University 1946; M.S. Oklahoma State University 1955; Ph.D. Iowa State University 1960, Factors Affecting Success of Beginning Farmers.

EBER WILLIAM ELDRIDGE, B.S. Iowa State University 1942; M.S. Michigan State University 1957; Ph.D. Iowa State University 1960, Relation of Occupational Plans of Iowa Farm Boys to Agricultural Adjustment.

RAYMOND O'CONNOR FARRISH, B.S. Cornell University 1952; M.S. University of Connecticut 1957; Ph.D. University of Connecticut 1960, Estimation of Broiler Output and Price.

JOHN NELSON FERRIS, B.S. Purdue University, 1951; M.S. Cornell University, 1952; Ph.D. Michigan State University, 1960, Dynamics of the Hog Market with Emphasis on Distributed Lags in Supply Response.

LEHMAN BLANTON FLETCHER, B.S. University of Florida 1954; Ph.D. University of California 1960, Growth and Adjustment of the Los Angeles Milkshed: A Study in the Economics of Location.

WALTER MERRILL FURBAY, B.S. Ohio State University 1941; M.S. Ohio State University 1956; Ph.D. Ohio State University 1960, An Analysis of the Sale of Inexpensive Cut Flowers and Potted Plants through Supermarkets.

GEORGE ROBINSON FUTHEY, B.S. Ohio State University 1954; M.S. Ohio State University 1955; Ph.D. Pennsylvania State University 1960, Appraisal of an Economic Model for Use in Estimating Farm Output Response.

B. DELWORTH GARDNER, B.S. University of Wyoming 1953; M.S. University of Wyoming 1954; Ph.D. University of Chicago 1960, Misallocation of Resources on Federal Range Lands.

RAYMOND WALTER GIESEMAN, B.S. Kansas State College 1955; M.S. Michigan State University 1956; Ph.D. North Carolina State College 1960, Explanation of Consumer Behavior in Terms of Want-Satiation Measures for Goods.

CURTISS CLARK HARRIS, JR., B.S. University of Florida 1956; A.M. Harvard University 1959; Ph.D. Harvard University 1960, Direct Production Payments in Agriculture.

LOYAL MERLYN HARTMAN, B.S. Colorado State University 1954; M.S. Colorado State University 1955; Ph.D. North Carolina State College 1960, Influence of Federal Acreage Controls on Costs and Production Practices for Tobacco.

JOSEPH HAVLICEK, JR., B.S. Ohio State University 1955; M.S. Ohio State University 1956; Ph.D. North Carolina State College 1960, Choice of Optimum Rates of Nitrogen Fertilization for Corn on Norfolk-Like Soil in the Coastal Plain of North Carolina.

YUJIRO HAYAMI, B.A. University of Tokyo 1956; Ph.D. Iowa State University 1960, Poultry Supply Functions.

JOSEPH CHARLES HEADLEY, B.S. University of Illinois 1952; M.S. University of Illinois 1955; Ph.D. Purdue University 1960, The Contribution of Supplemental Irrigation to Agricultural Output in the Eastern United States.

STEPHEN JAMES HIEMSTRA, B.S. Iowa State College 1953; M.S. Iowa State College 1957; Ph.D. University of California 1960, Structural Changes in California Food Retailing.

PAUL H. HOEPNER, B.S. Cornell University 1955; M.S. Cornell University 1956; Ph.D. University of Minnesota 1960, An Economic Analysis of Risk and Uncertainty in Dairy and Hog Production.

RANDALL ARNOLD HOFFMANN, JR., B.S. Iowa State University 1950; M.S. Iowa State University 1951; Ph.D. Iowa State University 1960, Income and Resource Changes Resulting from Farm Consolidation in Southwest Iowa.

ROBERT L. HOLLAND, B.S. University of Tennessee 1951; M.S. University of Tennessee, 1956; Ph.D. Texas Agricultural and Mechanical College 1960, A Market Classification System for Grease Wool to Facilitate Marketing on an Objective Basis.

ANDREAS AUGUST HOLMSEN, M.S. Royal Norwegian Agricultural College 1955; Ph.D. Cornell University 1960, Variability in Income and in Factors Affecting Income on Commercial Dairy Farms in the North Country and Central Plain Regions of New York State.

ROBERT WOLFE HOOD, B.S. Cornell University 1955; M.S. Purdue University 1957; Ph.D. Purdue University 1960, An Evaluation of the Economics of Product Selection Problems for Multi-Product Fluid Milk Plants.

HARRISON HSIA, B.S. University of Nanking 1942; M.S. University of Wisconsin 1953; Ph.D. University of Wisconsin 1960, Economic Decision Making in Hog Feeding—A New Approach.

VERNER GENE HURT, B.S. Mississippi State College 1950; M.S. Mississippi State College 1955; Ph.D. Oklahoma State University 1960, Capital Investment and Resource Adjustments on Individual Farms in the Ouachita Highlands of Oklahoma.

JACK TATSUMI ISHIDA, B.A. University of Hawaii 1942; M.A. University of Hawaii 1947; Ph.D. Purdue University 1960, Analysis of External Economic Factors Affecting the Success of Indiana R.E.M.C.'s.

ROBERT ERWIN JACOBSON, B.S. University of Illinois 1953; M.S. University of Illinois 1956; Ph.D. University of Illinois 1960, An Analysis of the Effect of the Dairy Price Support Program on Prices and Consumption of Frozen Desserts, Cheese, and Butter.

JOHN EDWARD KADLEC, B.S. Purdue University 1953; M.S. Purdue University 1957; Ph.D. Purdue University 1960, Alternative Models for Predicting the Supply of Milk in the Louisville Milk Shed.

IVAN LIDDEL KINNE, B.S. Cornell University 1953; M.S. Iowa State College 1957; Ph.D. Cornell University 1960, An Analysis of Costs and Economic Efficiency in New York State Apple Packing Houses.

MAX RAYMOND LANGHAM, B.S. University of Illinois 1952; M.S. University of Illinois 1958; Ph.D. University of Illinois 1960, Effects of Economic Adjustments on the Supply of Milk From Farms in Northeastern Illinois.

ARNOLD BENDIK LARSON, B.S. University of Minnesota 1949; M.S. University of Minnesota 1951; Ph.D. Stanford University 1960, Evidence on the Temporal Dispersion of Price Effects of New Market Information.

JAMES HUBERT LEWIS, B.S. Ohio State University 1953; M.S. Ohio State University 1954; Ph.D. Ohio State University 1960, An Analysis of Market

Structure and Spatial Price Patterns for Hogs and Pork and Pork Products in Ohio.

QUENTIN WILLIAM LINDSEY, B.S. University of Nebraska 1948; A.M. University of Nebraska 1950; Ph.D. Harvard University 1960, The Problem of Periodic Reorganization in Agriculture.

GERALD EUGENE MAROUSEK, B.S. South Dakota State College 1951; M.S. South Dakota State College 1954; Ph.D. Oklahoma State University 1960, An Economic Analysis of the Effects of Alternative Shearing Methods on Wool Quality in Eastern South Dakota.

DOUGLAS MCCONNELL, B.A. University of Texas 1956; M.A. University of Texas 1958; Ph.D. University of Wisconsin 1960, Selection of Farm Plans Under Alternative Soil Conservation Practices for a Representative Farm on the Fayette Soil of Southwest Wisconsin.

RICHARD JOSEPH MCCONNEN, B.S. Montana State College 1952; M.S. Montana State College 1954; Ph.D. University of California 1960, The Economics of Range Fertilization in California.

LUIS A. MEJIA-MATTEI, B.S.A. University of Puerto Rico 1949; M.S. University of Wisconsin 1958; Ph.D. University of Wisconsin 1960, An Integrated and Diversified Local Cooperative—A Case Study.

ELMER LYLE MENZIE, B.S.A. (Honours) University of British Columbia 1952; M.S.A. University of British Columbia 1955; Ph.D. University of California 1960, Section 22 of the Agricultural Adjustment Act of 1933: A Study in Public Policy Formation and Administration.

RUSSELL EDWARD MOFFETT, B.S. Michigan State College 1956; M.A. University of California 1959; Ph.D. University of California 1960, Water Resource Investment, with Particular Attention to Uncertainty.

WILLIAM CALVIN MOTES, B.S. Kansas State College 1954; M.S. Kansas State College 1958; Ph.D. Iowa State University 1960, Effects of Changes in Transportation Costs on the Location of the Meat Packing Industry.

RALPH E. NELSON, B.S. University of Minnesota 1949; M.S. University of Minnesota 1952; Ph.D. University of Minnesota 1960, The Nature of Competition Among South Dakota Dairy Manufacturing Plants.

RICHARD KENNETH NOLES, B.S. University of Florida 1955; M.S. University of Florida 1957; Ph.D. University of Illinois 1960, Consumer Egg Preferences and Their Relationship to Federal Standards.

JERRY HILL PADGETT, B.S. Clemson College 1954; M.S. Clemson College 1955; Ph.D. Purdue University 1960, More Efficient Transportation Patterns and Marketing Methods for Indiana Dairy Products.

KESAVA P. PANIKAR, B.A. Annamalai University (India) 1949; Ph.D. Vanderbilt University 1960, An Essay on Rural Savings in India.

REX ALAN PATTERSON, B.Com. University of Queensland 1950; M.S. University of Illinois 1959; Ph.D. University of Illinois 1960, The Economics of Transportation Development in Northern Australia.

TRAVIS DENTON PHILLIPS, B.S. Mississippi State University 1954; M.S. Mississippi State University 1955; Ph.D. North Carolina State College 1960, A Spatial and Seasonal Analysis of Corn Prices in North Carolina.

THOMAS THEOBALD POLEMAN, JR., B.S. University of Missouri 1951; M.S. University of Missouri 1952; Ph.D. Stanford University 1960, Agricultural Development in the Tropics: A Case Study of the Papaloapan Basin (Mexico).

LEONIDAS POLOPOLUS, B.S. University of California 1955; Ph.D. University of California 1960, U.S. Beet Sugar: A Study of Industry Structure and Performance Under Protection and Control.

EMILIO U. QUINTANA, B.S.A. University of Philippines 1952; M.S. Cornell University 1954; Ph.D. Purdue University 1960, Resource Productivity Estimates for Five Types of Philippine Farms.

ROBERT MOFFETT REESER, B.S. Ohio State University 1948; M.S. Ohio State University 1956; Ph.D. Ohio State University 1960, Land Use in Ohio: Trends, Prospects and Evaluation.

JOHN R. SCHMIDT, B.S. University of Wisconsin 1951; Ph.D. University of Minnesota 1960, Farm Organization as Influenced by Forage Acreage.

STANLEY RAY SCHULTZ, B.S. Ohio Wesleyan University 1951; M.S. Ohio State University 1957; Ph.D. Ohio State University 1960, An Economic Analysis of Manufacturing Milk Production in Ohio.

JOHN BERNARD SJO, B.S. Kansas State College 1949; M.S. Kansas State College 1952; Ph.D. Michigan State University 1960, Technology: Its Effect on the Wheat Industry.

FRANCIS JAMES SMITH, JR., B.S. California State Polytechnic College 1948; M.S. Purdue University 1952; Ph.D. University of California 1960, The Impact of Technological Change on the Marketing of Salinas Lettuce.

MELVIN WAYNE SMITH, B.S. Alabama Polytechnic Institute 1951; M.S. Alabama Polytechnic Institute 1958; Ph.D. Ohio State University 1960, An Analysis of the East Cleveland Farmers' Market.

DONALD DOYLE STEWARD, B.S. Ohio State University 1949; Ph.D. Ohio State University 1960, Income, Employment and Resource Use Among Rural Families in Southeastern Ohio.

DAVID ALDEN STOREY, B.S. University of Massachusetts 1954; M.S. Purdue University 1958; Ph.D. Purdue University 1960, Market Performance in the Perishable Bakery Products Industry.

JOHN RICHARD TEDFORD, B.S. University of Connecticut 1950; M.S. University of Connecticut 1951; Ph.D. Iowa State University 1960, A Statistical Analysis of Some of the Admissible Hypotheses Underlying the Demand for Food Products.

JOHN E. THOMPSON, B.S. University of South Dakota 1950; M.S. South Dakota State College 1953; Ph.D. University of Wisconsin 1960, Financing Public Education in South Dakota.

DONALD LEROY VOGELSANG, B.S. Iowa State College 1951; M.S. Purdue University 1956; Ph.D. Purdue University 1960, National and Regional Agricultural Production Adjustments and Required Payments Under Various Soil-Bank Proposals.

FRANCIS EDWARD WALKER, B.S. University of Illinois 1954; M.S. University of Illinois 1958; Ph.D. University of Illinois 1960, Methods of Measuring Seasonal Changes in Demand for Broilers.

LUTHER TOMPKINS WALLACE, JR., A.B. Harvard University 1949; M.S. Oregon State College 1955; Ph.D. Purdue University 1960, Factors Affecting Industrial Location in Southern Indiana.

HSIN FU WANG, B.S. National Central University (Nanking, China) 1947; M.S. Michigan State University, 1957; Ph.D. Michigan State University, 1960, Retail Food Price Index Based on M.S.U. Consumer Panel.

ELDON EDDEINE WEEKS, B.S. State College of Washington 1953; M.A. State College of Washington 1955; Ph.D. Pennsylvania State University 1960,

Economic Analysis of the Use of Nitrogen Fertilizer on Forage Crops in Pennsylvania.

EDWIN RUSSELL WESTCOTT, B.S. Ohio State University 1950; Ph.D. Ohio State University 1960, Optimum Combination of Resources for Dairy Farms in West-Central Ohio.

STEPHEN F. WHITTED, B.S. University of Missouri 1951; M.S. University of Missouri 1954; Ph.D. University of Missouri 1960, Alternative Uses of Surplus Grade A Milk.

LOWELL EDWIN WILSON, B.S. Murray (Kentucky) State College 1953; M.S. University of Kentucky 1957; Ph.D. University of Illinois 1960, Factors Associated with the Incidence of Low Income Farms in Illinois Area.

NORMAN WILSON, A.B. Morehouse College 1935; M.S. Brigham Young University 1939; Ph.D. University of Missouri 1960, Meat Consumption Patterns Among Columbia Negroes.

ALMER WAYNE WOODARD, B.S. University of Tennessee 1947; M.S. University of Tennessee 1954; Ph.D. Michigan State University 1960, Efficiency in Cotton Marketing With Special Emphasis on County Marketing Program Adjustment.

DAN YOUNG, M.S. The Hebrew University 1955; Ph.D. Iowa State University 1960, Resource Allocation for Dairy and Field Crops in the Negev Area of Israel.

PINHAS ZUSMAN, M.S. The Hebrew University, Jerusalem, 1956; M.A. University of California 1960; Ph.D. University of California 1960, Econometric Analysis of California Early Potato Market.

NEWS NOTES

NORRIS ANDERSON, South Dakota State College, returned April 1 to Colorado, to work in the area of agricultural finance.

DAVID C. ARMS accepted a position with the Dairy Division, AMS, following completion of his graduate studies at Penn State in February.

GEORGE H. AULL, Clemson College, has been reappointed by the Board of Governors to a second three-year term as a Director, Charlotte Branch, Federal Reserve Bank of Richmond. At the January meeting Dr. Aull's fellow directors elected him Chairman of the Charlotte Board for the year 1961.

HENRY BAKKEN, Professor of Agricultural Economics at the University of Wisconsin, has been granted a leave of absence until June, 1961, so that he could serve on a committee for the Organization of American States studying the economy of Honduras. The aim of the committee is to suggest ways of stabilizing the economy.

A. GORDON BALL has been appointed a Professor of Economics in the Department of Economics and Sociology at Iowa State University (Ames) beginning July 1. He is returning to Iowa State University after spending a year at the University of Alberta.

RALPH U. BATTLES, formerly with the Research and Information Division, Farm Credit Administration, was appointed Deputy Chief of the Agricultural Institutions Branch, Office of Food and Agriculture, International Cooperation Administration, effective February 9. He will be responsible for programs in agricultural credit, cooperatives, and marketing with ICA missions throughout the world. In the Farm Credit Administration he had taken the leadership in developing training programs for foreign visitors interested in agricultural credit, and had also served as consultant in this field to the agricultural banks in Iran and Turkey.

RAY BILLINGSLEY is on leave from Texas Technological College to the Population Research Center, University of Chicago, assigned to the University of Rangoon, Burma, as Visiting Professor of Economics. The assignment is to set up a program of teaching and research in Agricultural Economics.

UEL BLANK, formerly of the University of Missouri, has accepted the position of Assistant District Director of the Cooperative Extension and Continuing Extension Services for the Upper Peninsula of Michigan.

RUDOLPH C. BLITZ, Vanderbilt University, left for Santiago, Chile, on February 1. He will be serving as a Vanderbilt Overseas Professor at the University of Chile for a full academic year.

ROY A. BODIN, State Statistician in Charge at the St. Paul, Minnesota, Office, Agricultural Estimates Division, Agricultural Marketing Service, retired on March 6, after 34 years of Government Service.

JOHN A. BRITTAIN, Vanderbilt University, has received a Ford Foundation Faculty Research Fellowship for the academic year 1961-62.

THOMAS M. BROOKS, Agricultural Marketing Service, transferred from the Marketing Economics Research Division to the Public Programs Group of the Market Development Research Division, effective March 6, to work on new food distribution programs.

AUBREY J. BROWN, University of Kentucky, was reappointed as a Director of the Federal Reserve Bank of Cleveland.

DAVID W. BROWN joined the staff of the Department of Agricultural Economics and Sociology, Texas A. & M. College, on January 1, as Extension Economist in Farm Management. His major responsibility is to give technical leadership in Farm Management to the Extension Area Farm Management Specialists.

JAKE A. BROWN has been appointed Director of Research and Planning of the Agricultural Representative Services, Saskatchewan Department of Agriculture, Regina.

G. L. BURTON, has been made a member of the Board of Directors, Burns and Company Limited, Calgary, Alberta.

WENDELL CALHOUN retired January 6, after almost 35 years of service in the USDA in a wide and interesting variety of Activities. He started with the Extension Service in 1926. He was in Market News in the Fruit and Vegetable Division from 1933-39, and since 1939 he has been in the Division of marketing and Transportation Research of the Bureau of Agricultural Economics and its successor agencies in the Agricultural Marketing Service. Mr. Calhoun played an important role in organizing the Western Agricultural Economics Research Council and was its Secretary for almost ten years.

GLENN CARTER recently completed work for the Master's degree at Penn State and accepted the position of executive secretary of the Pennsylvania Council of Farmer Cooperatives.

WILLARD W. COCHRANE was designated on February 24 as Acting Director, Agricultural Economics, in USDA, pending official action to place in effect organizational changes in this area of work of the Department. He was assigned responsibility for arrangements incident to the transfer of related statistical reporting and economic research functions.

GEORGE CONNEMAN, Assistant Professor at Cornell, is spending some time at Pennsylvania State University working toward a Ph.D.

JOHN W. COUSTON, formerly of the Agriculture Division, Dominion Bureau of Statistics, Ottawa, is now on the staff of the FAO in Rome, Italy.

JOHN F. CRUM transferred on January 21 from the Fruit and Vegetable Statistics Branch, Agricultural Estimates Division, AMS, to the Agricultural Economics Division, where he will conduct economic and statistical research on fruits and vegetables and prepare situation and outlook reports on these commodities.

JOHN M. CURTIS, In Charge of Extension Marketing in North Carolina, will transfer in June to the University of Maryland, where he has accepted appointment as Professor and Head, Department of Agricultural Economics.

RILEY S. DOUGAN, Ohio State University, accepted the position as Leader of Agriculture–Farm and Industry in Agricultural Extension Administration effective January 1. He is also nominally appointed as Associate Professor in the Department of Agricultural Economics and Rural Sociology.

J. NORMAN EFFERSON, Dean of the College of Agriculture at Louisiana State University, LAUREN SOTH, of the Des Moines Tribune, and JESSE TAPP, of Bank of America, served on President Kennedy's recent task force on Agricultural Policy. The group met with Mr. Kennedy in February to present their report on immediate policy needs.

RAYMOND O. FARRISH resigned April 1, from the staff of the University of Connecticut to accept a position in the Marketing Economics Research Division, AMS, in Washington, D.C.

ERNEST FEDER has resigned from the University of Nebraska, Department of Agricultural Economics, to accept a position with the International Cooperation Administration in Bogotá, Colombia.

I. F. FELLOWS, University of Connecticut, is on sabbatical leave at the University of California through August. He is doing research on resource utilization on California dairy farms.

WINN FINNER left for Jamaica via Mexico City in mid-December of 1960 for a one-year appointment with the Food and Agriculture Organization of the United Nations as a marketing adviser to the Jamaican Government to develop an improvement program in their national marketing.

WILLIAM J. FLUKE, transferred on February 20 from Field Crop Statistics Branch, Agricultural Estimates Division, AMS, in Washington, D.C., to the State Statistician's Office at West Lafayette, Indiana.

GLEN D. FULCHER of the Department of Agricultural Economics, University of Nevada, will leave June 1 for a two year assignment in Paraguay as a member of the three man team from Montana State College to assist the University of Paraguay in establishing a College of Agriculture.

ROBERT L. FULTON, California Department of Water Resources, took leave of absence last August to accept a position with the International Cooperation Administration as Agricultural Program Officer in New Delhi, India.

FRANCIS J. GRAHAM, Secretary, Crop Reporting Board, USDA, was appointed State Statistician in Charge at the St. Paul Office, Agricultural Estimates Division, on March 1.

JAMES GRAVES, who has completed work for his Ph.D. at Michigan State University, is now an Assistant Professor in the Agricultural Economics Department at Texas Technological College, Luddock.

RICHARD HALL, Market Development Research Division, AMS, received in January a Certificate of Merit and cash award.

H. H. HANNAM was re-elected President of the Canadian Federation of Agriculture at its recent annual meeting.

DONALD F. HAYTHORNE, formerly with Prudential Insurance Company of America, has joined the staff of the Economics Division, Canada Department of Agriculture, Edmonton, Alberta.

CLIFFORD HILDRETH, Michigan State University, will spend the 1961-62 academic year as a Fellow in the Center for Advanced Study in the Behavioral Sciences at Palo Alto, California.

LLOYD I. HOLMES, formerly with the Livestock Division, Agricultural Marketing Service, USDA, transferred in April to the Oils and Peanut Division, Commodity Stabilization Service.

LORNE W. J. HURD has been elected President of the Canadian Farm Writers Federation.

GORHAM HUSSEY, Purdue University, has recently accepted appointment to the Economics Analysis staff of Armour and Company of Chicago.

SYDNEY JAMES, who completed the requirements for the Ph.D. degree at Oregon State College in October, has accepted a position at the University of New Mexico as Assistant Professor of Agricultural Economics.

J. J. JEANNEAU, formerly with the Saskatchewan Department of Agriculture, Regina, has been appointed agricultural extension economist with the Manitoba Department of Agriculture at Brandon, Manitoba.

D. GALE JOHNSON, University of Chicago, planned and presided over a Conference on the Relations Between Agriculture and Economic Growth,

Stanford University, November 11-12, 1960. The conference was sponsored by the Social Science Research Council.

ARCADIUS KAHAN, University of Chicago, who has been specializing on Soviet Agriculture, holds a research fellowship at the Russian Research Center, Harvard University. Professor Kahan will be on leave from the University of Chicago until July of 1961.

ORVAL KERCHNER, Marketing Economics Research Division, AMS, recently transferred to St. Paul, where he is attending the University of Minnesota and working half-time on a cooperative project.

GORDON C. KLEIMAN, general manager of Grand Rapids Produce, Inc., and the Kalamazoo Fruit Co., has been elected to the Advisory Board of the United Fresh Fruit and Vegetable Association.

MELVIN L. KOEHN has been made Acting Secretary of the Crop Reporting Board, Agricultural Estimates Division, AMS, Washington, D.C.

MAX R. LANGHAM has joined the staff of Louisiana State University as Assistant Professor of Agricultural Economics upon completion of work for the Ph.D. at the University of Illinois.

ERVIN LONG of International Cooperation Administration, RAYMOND J. PENN, University of Wisconsin, and HARRY STEELE, USDA, participated in an I.C.A. seminar on Latin American land development and land reform, held February 21-24 in Santiago, Chile. I.C.A. personnel from 20 Latin American countries attended. En route to the seminar, Long, Penn, and Steele visited Guatemala, Costa Rica, and Colombia to observe some of the land development programs in which the U.S. has been participating.

JAMES C. MANESS of the Georgia Extension Service has been appointed Instructor in the Department of Agricultural Economics at Louisiana State University. Mr. Maness will work in the area of Poultry and Egg Marketing and Cooperatives.

JAMES E. MARTIN has been appointed a Research Associate in the Department of Economics and Sociology at Iowa State University (Ames).

EDWARD J. MCGRATH, Market Development Research Division, AMS, received in January a Certificate of Merit and cash award.

JAMES F. MILES, Clemson College, has accepted an invitation from the International Cooperation Administration to serve as a Marketing Consultant to the government of San Salvador. He will be granted a 60 day leave from his duties as Associate Agricultural Economist on the Experiment Station Staff at Clemson.

JARVIS E. MILLER, Texas A. & M. College, left February 1 for Argentina to be an Agricultural Economics Advisor with the U. S. Operations Mission of the International Cooperation Administration. Dr. Miller will work with Argentine agricultural officials on livestock marketing research. He will return to Texas A. & M. at the end of two years.

RUSSELL E. MOFFETT, who recently completed his requirements for the Ph.D. degree at the University of California, has joined the staff of the University of Connecticut as Assistant Professor of Agricultural Economics.

WILLARD F. MUELLER, Associate Professor of Agricultural Economics at the University of Wisconsin, has been granted a leave of absence until July, 1962, to serve as Chief Economist to the House of Representatives Small Business Committee.

PAUL G. MULLER has joined the Market Research Department of Alcan International, Montreal.

MAX MYERS, Administrator, Foreign Agricultural Service, USDA, since July 1958, resigned effective March 4. Mr. Myers was formerly on the faculty of South Dakota State College. He plans to spend about two months on vacation and personal business and to announce his future plans late in the Spring.

RAYMOND C. NICHOLSON has been appointed assistant professor of farm management at the University of Saskatchewan.

DON PAARLBERG, former Special Assistant to President Eisenhower and Food-For-Peace Coordinator, has been appointed Distinguished Professor of Agricultural Economics at Purdue University. Dr. Paarlberg will direct his research and teaching energies to the fields of international economics and policy.

DAN PADBERG, University of California, will join the Agricultural Economics and Rural Sociology staff at Ohio State as Assistant Professor in the area of Market Structure effective June 1.

H. L. PATTERSON, Director, Farm Economics and Statistics Branch, Ontario Department of Agriculture, was recently elected Chairman of the Departmental Council. He is also chairman of two Enquiry Committees for the Ontario Department of Agriculture on Grain Marketing and on Problems of Tobacco Marketing.

DARREL D. PENNINGROTH has joined the staff of the Milk Market Administrator at Phoenix, Arizona, upon completion of the M.S. degree in agricultural economics at the University of Illinois.

M. GLADE PINCOCK, who has completed his Ph.D. at Cornell University, joined the staff of the Economics Department at South Dakota State College on March 1.

HOMER PONDER has been appointed an Instructor in the Department of Agricultural Economics at Louisiana State University. Mr. Ponder is working on interregional competition in sweet potato production and marketing.

JOHN R. PRICE, transferred from the Crop Reporting Board, Washington, D.C., Agricultural Estimates Division, AMS, to the Office of the State Statistician at Oklahoma City, effective January 23.

DAVID ROZMAN retired from the University of Massachusetts in April. He had completed thirty-three years there on the staff in Land Economics.

THEODORE W. SCHULTZ, University of Chicago, will serve as a member of the Board of Directors of the Center for International Economic Growth. He has also been appointed to the new committee established by the National Science Foundation on Economic and Statistical Studies of Science and Technology.

WOLFGANG M. SCHULTZ, joined the staff of the Economics Department, South Dakota State College, February 1. He received his Ph.D. degree from Oklahoma State University.

FRANK S. SCOTT, JR., Professor of Agricultural Economics at the University of Hawaii, is on leave during 1961 on a FAO assignment to train Argentine economists for agricultural marketing research positions with the Instituto Nacional De Technologia Agropecuaria.

R. E. SELTZER has resigned as Head of the Department of Agricultural Economics at the University of Arizona to accept a position as Director of Economic Research with Agriresearch, Inc., a new private agricultural research firm located at Manhattan, Kansas.

THOMAS STOUT, Purdue University, has accepted an appointment as Associate

Professor of Marketing in the Department of Agricultural Economics and Rural Sociology at Ohio State University, effective July 1. He will work in the area of livestock marketing.

GENE SULLIVAN has been made Instructor in the Department of Agricultural Economics at Louisiana State University. Mr. Sullivan is working on an economic analysis of fertilizer use for Louisiana soils and crops.

ANTHONY M. TANG, Vanderbilt University, has received a travel grant from the Social Science Research Council and the American Council of Learned Societies Joint Committee on Contemporary China to permit him to visit the various centers of Chinese economic studies in the United States preparatory to developing a research project on the economics of Mainland China.

BYRON TAYLOR joined the Extension Economics Staff at South Dakota State College, January 1 as Extension Livestock Marketing Specialist.

MICHAEL S. TURNER, Ohio State University, accepted a position as Assistant Instructor in the Department of Agricultural Economics and Rural Sociology in Grain Marketing effective January 16, after receiving his Master's Degree from Ohio State.

AKIRA UCHIDA resigned as research assistant at the Pennsylvania State University on February 1 to return to Japan. He has accepted a position in Yokohama with the Sakota Seed Company.

WILLIAM A. WAYT, Ohio State University, will be on leave of absence for one year beginning July 1, as Associate Professor and Department Head of Agricultural Economics with the Oklahoma State University Contract Team at the Imperial Ethiopian College, Dire Dawa.

MARGARET H. WEIDENHAMER, Market Development Research Division, AMS, received in January a Certificate of Merit and cash award.

BERNIS WILLIAMSON has been named coordinator for a study of problems of small agricultural businesses that is being conducted by the Department of Agricultural Economics at Louisiana State University.

JEFFREY G. WILLIAMSON of Stanford University has accepted an appointment as an Assistant Professor of Economics at Vanderbilt University effective next September 1.

LAWRENCE W. WITT, Michigan State University, spent January 23 to March 23 as consultant to the Director of the Food-For-Peace Program in Washington, D.C.

G. BURTON WOOD, Head of the Department of Agricultural Economics, Oregon State College, left on January 5 for a three and one-half months trip around the world. Dr. Wood will review the educational activity being sponsored by the Council on Economic and Cultural Affairs in Southeastern Asia with a view to improvements in the program and to become better acquainted with the needs of students who come to the United States for training. Dr. Wood will also visit the common market countries of Europe for a better understanding of the economic conditions there. He will return to Corvallis on April 15.

MARY ZEHNER, Michigan State University, has completed work for the Master's degree and has joined the staff as Instructor in the Agricultural Economics Department as a Consumer Marketing Extension Specialist.

DONALD E. ZEHR, Ohio State University, resigned his position as Instructor in the Department of Agricultural Economics and Rural Sociology to accept the position of Manager of the Central Ohio Milk Producers' Cooperative, effective March 15.

ORGANIZATIONAL ANNOUNCEMENTS

The U.S. Department of Agriculture announced on February 24 that decision had been made to realign functional activities involving research in agricultural economics and statistical reporting as a separate grouping of program agencies under general direction and supervision of a Director, Agricultural Economics, attached to the Office of the Secretary. The adjustments involved include: a Statistical Reporting Service, to be headed by an Administrator, including basically the program responsibilities of the Agricultural Estimates and Statistical Standards Divisions of the Agricultural Marketing Service, with related and supporting activities; and an Economic Research Service, to be headed by an Administrator, including basically the program responsibilities of the Agricultural Economics Division, the Market Development Research Division, the Marketing Economics Research Division, the Chairman of the Outlook and Situation Board, and functions of the Deputy Administrator, Economics and Statistics, all in the Agricultural Marketing Service; functions of the Farm Economics Research Division, in Agricultural Research Service; and the Foreign Agricultural Analysis Division and the International Monetary and Trade Statistics Branches of the Trade Policy Division, in Foreign Agricultural Service; along with related and supporting activities.

A supplemental announcement shifts the Market Surveys Branch of the Market Development Research Divison to the Statistical Reporting Service, and assigns certain economic research activities of the Transportation and Facilities Research Division to the Economic Research Service.

Willard W. Cochrane has been designated Director, Agricultural Economics, with responsibility for coordinating all statistical and related economic analysis work for the Department.

Harry C. Trelogan has been designated Administrator of the Statistical Reporting Service, with Sterling R. Newell as Deputy Administrator. Richard K. Smith is Director, Agricultural Estimates Division; Earl E. Houseman, Director, Statistical Standards Division; and Glenn D. Simpson, Director, Field Operations Division.

Nathan M. Koffsky has been designated Administrator of the Economic Research Service, with Sherman E. Johnson as Deputy Administrator, Foreign Agriculture, and Bushrod W. Allin as Chairman of the Outlook and Situation Board. Frederick V. Waugh is Director, Economic and Statistical Analysis Division; Kenneth E. Ogren, Director, Marketing Economics Division; and Carl P. Heisig, Director, Farm Economics Division. Reporting to the Deputy Administrator, Foreign Agriculture, are Wilhelm Anderson, Director, Regional Analysis Division, and Kenneth L. Bachman, Director, Development and Trade Analysis Division.

A Staff Economists Group has been established in the office of the Director, Agricultural Economics. O. J. Scoville, J. A. Schnittker, and Linley Juers have been appointed to this group.

Decision has also been announced to place the Agricultural Conservation Program Service in the Commodity Stabilization Service; to place the functions of the General Sales Manager and the Barter and Stockpiling Division, Commodity Stabilization Service, in the Foreign Agricultural Service; and to place work of the Agricultural Marketing Service on marketing orders and agreements, except fruits and vegetables, in the Commodity Stabilization Service.

At the University of Massachusetts, the Board of Trustees has changed the name of the Department of Agricultural Economics to the Department of Agricultural and Food Economics.

The Alberta Department of Agriculture has established a Farm Economics Branch. Transferred from other branches in the Department to the Farm Economics Branch are B. J. McBain, T. A. Petersen, J. Ackerman, C. H. Ferries and K. D. Porter.

The American Marketing Association's 1961 National Conference will be held June 19-21 at the Los Angeles Ambassador. Its subject will be "Zeroing in the potent marketing tools of advertising, selling, merchandising and marketing research on the corporate profit target." The conference will include presentations on "New Directions in Agricultural Marketing," by Elmer C. Denis, Doane Agricultural Service, and on "Marketing Law and Regulation," by Howard Stier, National Canners Association; also a session on long-range planning for consumer goods, to be led by Joseph Bradley of Pillsbury Company.

The 1961 session of the Southern Regional Graduate Summer Session in Statistics will be held at the Virginia Polytechnic Institute, Blacksburg, Virginia, from June 15 to July 22, 1961.

The Virginia Polytechnic Institute, Oklahoma State University, North Carolina State College, and the University of Florida have agreed to operate a continuing program of graduate summer sessions in statistics to be held at each institution in rotation. The program was instituted at Virginia Polytechnic Institute in the summer of 1954.

The 1961 session, like previous sessions under this program, is intended to serve: 1) teachers of statistics and mathematics; 2) professional workers who want formal training in modern statistics; 3) research and engineering personnel who want intensive instruction in basic statistical concepts and modern statistical methodology; 4) Public Health statisticians who wish to keep informed about advanced specialized theory and methods; 5) prospective candidates for graduate degrees in statistics; and 6) graduate students in other fields who desire supporting work in statistics.

The session will last six weeks and courses will carry five quarter hours of credit. Not more than two courses may be taken for credit at any one session. The summer work in statistics may be applied as residence credit at any of the cooperating institutions, as well as certain other universities, in partial fulfillment of the requirements for a graduate degree.

The courses to be offered are: Statistical Methods, Sampling Theory; Applied Statistics for Engineers and Physical Sciences; Theory I, Probability; Theory II, Statistical Inference; Theory III, Theory of Linear Hypotheses; Non-parametric Methods; and Multivariate Methods.

A number of courses in advanced mathematics will be available during the Summer Session. A series of Colloquia involving recent developments in statistical theory and methods will be conducted during the special Summer Session.

Requests for application blanks for the summer session and for fellowships should be addressed to Dr. Boyd Harshbarger, Head, Department of Statistics, Virginia Polytechnic Institute, Blacksburg, Virginia.

The University of Nebraska, with the assistance of several other organizations, is planning a Homestead Centennial Symposium for June 10-14, 1962. This symposium will take the occasion of the pasasge of the Homestead Act in 1862 to review present land problems and future land policies of the United States.

The symposium will occur in two segments. The first day, June 10, 1962, will involve a major public program at the Homestead site, near the city of Beatrice. The symposium itself will be held on June 11-14, at the new Nebraska Center for Continuing Education at Lincoln. Competent scholars from over the country will give papers on the historical, political, and economic issues of land policy—past, present, and future.

For further information contact Howard W. Ottoson, Chairman, Department of Agricultural Economics, University of Nebraska, Lincoln, Nebraska.

JOINT ANNUAL MEETING OF THE AMERICAN FARM ECONOMIC ASSOCIATION AND THE WESTERN FARM ECONOMICS ASSOCIATION

Colorado State University, Ft. Collins
August 13-16, 1961

PROGRAM

Sunday, August 13

9:00 Executive Committee Meeting

1:00 Registration

2:00 Executive Committee Meeting

Monday Morning, August 14

9:00 The "New" Agricultural Program—For Better or For Worse?
Chairman: D. Gale Johnson, University of Chicago
Papers: The Administration's Score on the First Round
George Tolley, North Carolina State College
The Shaplessness of Farm Policy
George Brandow, Pennsylvania State University

11:00 Presidential Address: Relevant Farm Economics
Bushrod W. Allin, Economic Research Service, USDA

Monday Afternoon, August 14

2:00 Contributed Papers: Consumption, Marketing and Prices
Chairman: Richard L. Kohls, Purdue University

2:00 Contributed Papers: The Agricultural Economics Curriculum, Graduate and Undergraduate
Chairman: C. Peairs Wilson, Kansas State University

2:00 The Scope Effort of Extension and Agricultural Economics
Chairman: Robert W. Wilcox, University of Idaho
Papers: The Implications of the Scope Effort to Agricultural Economics
Lloyd Davis, Associate Director of Extension, Massachusetts
Contributions of Agricultural Economists to the Scope Effort
Roland Abraham, Assistant Extension Director, Minnesota
The Scope Effort as Viewed by an Agricultural Economics Specialist
Leslie Stice, University of Illinois
Discussants: George Abshier, Oklahoma State University
Ted Atkinson, University of Arkansas
Roger H. Wilcowske, Kansas State University

2:00 ADJUSTING LIVESTOCK FARMS TO THE PROSPECTS OF THE 1960's
Chairman: EARL R. SWANSON, University of Illinois
Papers: Southern States
J. H. BLACKSTONE, Auburn University
North-Central States
LEE M. DAY, Economic Research Service, USDA (University of Minnesota)
Western States
ELMER C. HUNTER, Economic Research Service, USDA (Colorado State University)
Discussants: LEE R. MARTIN, University of Arkansas
R. M. FINLEY, University of Nebraska
A. VANVIG, University of Wyoming

2:00 EMERGING PROBLEMS IN WATER ECONOMICS
Chairman: HARRY STEELE, Economic Research Service, USDA
Papers: Fund Resource Value of Ground Water
MAURICE M. KELSO, University of Arizona
Water Quality, A Problem for the Economist
S. V. CIRIACY-WANTRUP, University of California, Berkeley
Water Law, Its Importance to Economic Development
FRANK J. TRELEASE, University of Wyoming
Discussants: STEPHEN C. SMITH, University of California, Berkeley
H. R. STUCKY, New Mexico State University
JOHN R. GREENMAN, University of Florida

2:00 AN APPRAISAL OF THE RURAL DEVELOPMENT PROGRAM: THE FIRST SIX YEARS
Chairman: HAROLD F. BREIMYER, Council of Economic Advisers
Papers: Rural Development Achievements and Shortcomings as Seen at the Federal Level
DON PAARLBERG, Purdue University and formerly Assistant Secretary of Agriculture
Rural Area Development in a Growing Economy
ROBERT B. GLASGOW and FRANK T. BACHMURA, Economic Research Service, USDA
Rural Development Achievements and Shortcomings as Seen at the State Level
FRANK W. SHEPPARD, Texas A. & M. College
Discussants: LOUIS LEVINE, U.S. Bureau of Employment Security
EARL F. PETTYJOHN, University of Arkansas
MILTON H. STEINMUELLER, Michigan State University

Tuesday Morning, August 15

9:00 TOWARD AN INTERNATIONAL DIMENSION
Chairman: ROBERT C. TETRO, Foreign Agricultural Service, USDA
Papers: Training Needs for American Technical-Assistance Specialists Abroad
W. S. MIDDAUGH, International Cooperation Administration

International Opportunities for American Land-Grant Universities
Sherwood O. Berg, University of Minnesota
U.S. Investment in Human Beings Abroad
T. W. Schultz, University of Chicago
Discussants: Arthur Mosher, Council of Economic and Cultural Affairs
Anthony M. Tang, Vanderbilt University

Tuesday Afternoon, August 15

2:00 Contributed Papers: Farm Management and Production Economics
Chairman: Wylie D. Goodsell, Economic Research Service, USDA

2:00 Contributed Papers: Land Economics, Farm Finance, Institutional Economics
Chairman: Charles W. Loomer, University of Wisconsin

2:00 Agricultural Grading in the 1960's
Chairman: V. James Rhodes, University of Missouri
Papers: The Function of Grades in an Affluent, Standardized-Quality Economy
George L. Mehren, University of California, Berkeley
Economic Effects of Recent Changes in Lamb Standards
Darrell Fienup, University of Minnesota
A Merchandiser's View of the Function of Grades
Seth Shaw, Safeway Stores
Discussants: Herman M. Southworth, Pennsylvania State University
Roland Welborn, Swift and Company
Willard F. Williams, Oklahoma State University

2:00 Reorganizing Agricultural Economics Extension Work
Chairman: Byron E. Taylor, Marketing Specialist, South Dakota State College
Papers: A Critical Appraisal of the State of Agricultural Economics Extension Work Today
Elmer R. Kiehl, University of Missouri
Directions Needed in Extension Farm Management Work
Glen Pulver, University of Wisconsin
Directions Needed in Extension Marketing Work
Robert C. Kramer, Michigan State University
Directions Needed in Extension Public Policy Work
Wallace Barr, Ohio State University
General Discussion

2:00 Farm Labor and Labor Mobility
Chairman: Olaf F. Larson, Cornell University
Papers: The Use of Human Resources in Farm Production—Recent Trends and Changes in Prospect
Sheridan T. Maitland and Louis J. Ducoff, Economic Research Service, USDA

The Incidence of Increasing Wage Costs in Farm Production
FRANK H. MAIER, Economic Research Service, USDA
The Use of Foreign Labor for Seasonal Farm Work in the United States—Issues Involved and Interested Groups in Conflict
JOHN W. MAMER, University of Connecticut
Discussants: LOUIS LEVINE, U.S. Bureau of Employment Security
ERIC THOR, University of California, Berkeley
R. D. REHNBERG, Colorado State University

2:00 SIGNIFICANT CHANGES IN FOREIGN AGRICULTURE SINCE 1945
Chairman: JOSEPH ACKERMAN, Farm Foundation
Papers: India
D. G. KARVE, Federal Reserve Bank of India, Bombay
Brazil
RUY MILLER PAIVA, Division of Rural Economics, São Paulo Secretariat of Agriculture
Japan
KAZUSHI OHKAWA, Hitotsubashi University
Discussants: W. DAVID HOPPER, University of Chicago
BRUCE F. JOHNSTON, Stanford University
JIMMYE S. HILLMAN, University of Arizona

Tuesday Evening, August 15

8:00 AWARDS PROGRAM
Chairman: GEOFFREY S. SHEPHERD, Iowa State University

Wednesday Morning, August 16

8:00 Annual Business Meeting

9:00 ECONOMICS OF SOUTHERN PINE FORESTRY
Chairman: AYERS BRINSER, University of Colorado
Papers: The Demand for Southern Pine
JOSEPH ZAREMBA, State University of New York
The Changing Structure of the Southern Pine Lumber Industry
JAMES E. MOAK, Mississippi State College
Economic Problems of Growing Southern Pine
FRANK HEYWARD, Crown Zellerbach Corp., Bogalusa, Louisiana
Discussants: To be announced

9:00 WEATHER AND CROP YIELDS
Chairman: KENNETH L. BACHMAN, Economic Research Service, USDA
Papers: Feasibility and Significance to Economic Analysis of Adjusting U.S. Crop Output for Weather
JAMES L. STALLINGS, Economic Research Service, USDA (Lincoln, Nebraska)
Importance of Weather Variability on Management Decisions
R. J. HILDRETH, Texas A. & M. College

Use of Weather Factors in Short-run Forecasts of Crop Yields
R. K. SMITH, Statistical Reporting Service, USDA
Discussants: JAMES PLAXICO, Oklahoma State University
DON BOSTWICK, Economic Research Service, USDA (Bozeman, Montana)
ROBERT F. DALE, U. S. Weather Bureau, Ames, Iowa

9:00 IMPROVEMENT OF THE MANAGEMENT RESOURCES IN AGRICULTURE
Chairman: W. D. TOUSSAINT, North Carolina State College
Papers: Improved Managerial Processes for Farmers
JAMES NIELSON, Michigan State University
The Management Resource and Agricultural Marketing
CHARLES E. FRENCH, Purdue University
Teaching Managers How to Improve Their Decision-Making Process
STEPHEN J. BRANNEN, Georgia Agricultural Extension Service
Discussants: G. A. PETERSON, University of Wisconsin
ALLEN B. RICHARDS, General Mills, Inc.
C. B. BAKER, University of Illinois

9:00 APPLYING ECONOMICS IN AGRICULTURAL EXTENSION
Chairman: FRED L. OLSON, University of Nebraska
Papers: Use of Economic Theory in Problem Solving
JOHN C. DONETH, Michigan State University
Use of Economic Theory in Farm Management
BUEL F. LANPHER, JR., Federal Extension Service
Use of Economic Theory in Marketing
RICHARD PHILLIPS, Iowa State University
Use of Economic Theory in Public Affairs
W. L. TURNER, North Carolina State College
General Discussion

9:00 DO MARKET STRUCTURES INFLUENCE MARKET DEVELOPMENTS?
Chairman: STANLEY K. SEAVER, University of Connecticut
Papers: A Theoretical Scaffolding for Analysis of Market Structure
S. H. SOSNICK, University of California, Davis
The Effect of Market Orders on Market Structures and Some Consequent Market Developments
N. TOWNSHEND-ZELLNER, Economic Research Service, USDA
Empirical Measurement of Market Structure and Performance Relationships
W. F. MUELLER, University of Wisconsin
Discussants: R. W. RUDD, University of Kentucky
PAUL L. FARRIS, Purdue University
HOMER C. EVANS, University of West Virginia

9:00 ECONOMIES OF SCALE IN AGRICULTURAL PRODUCTION
Chairman: GEORGE T. BLANCH, Utah State University
Papers: Economies of Scale in Crop Production
J. E. FARIS, JR., University of California, Davis
Economies of Scale in Livestock Production
H. B. HOWELL, Iowa State University

Implications of Economies of Scale to National Agricultural Adjustment
M. L. UPCHURCH, Economic Research Service, USDA
Discussants: JAY SWANSON, Washington State University
LEO J. MORAN, Stanford Research Institute
R. H. MCALEXANDER, Pennsylvania State University

EMPLOYMENT SERVICE

The AFEA Employment Committee will provide placement service facilities similar to those of the past two meetings. Harry G. Sitler, Economics Research Service, has been designated local representative during the conference. Anyone wishing to register as potential employee or employer should write to him for the appropriate forms at the following address: Business and Economics Building, Colorado State University, Fort Collins, Colorado.

INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS
ELEVENTH CONFERENCE PROGRAMME

Cuernavaca, Mexico, August 19-30, 1961

THEME: THE ROLE OF AGRICULTURE IN ECONOMIC DEVELOPMENT

Sunday, August 20

AFTERNOON (AT 4:00): INAUGURAL MEETING
Welcome to conference
Presidential address

Monday, August 21

MORNING: PAPERS AND DISCUSSIONS
The concept of economic growth
Measuring economic growth and agriculture's contribution thereto
AFTERNOON: PANEL ON MEXICO
EVENING: COUNCIL MEETING

Tuesday, August 22

MORNING: PAPERS AND DISCUSSIONS
The agricultural economist and his tools
(a) *Research methods*
(b) *Extension work*
AFTERNOON: WORK GROUPS
EVENING: ENTERTAINMENT

Wednesday, August 23

MORNING: PAPER AND DISCUSSION
Indigenous and foreign investment in agricultural development
AFTERNOON: TOUR
EVENING: COUNCIL MEETING

Thursday, August 24

MORNING AND AFTERNOON: PAPERS AND DISCUSSIONS
Role of agriculture in economic development—country experiences
EVENING: ENTERTAINMENT

Friday, August 25

MORNING: PAPERS AND DISCUSSIONS
Developments in patterns of farm units
(a) *New lands and settlements*
(b) *Consolidating farms and improving layouts*
(c) *Experience with large-scale farms*
AFTERNOON AND EVENING: WORK GROUPS

Saturday, August 26

MORNING: PAPERS AND DISCUSSIONS
Market structure for agricultural development
Organisation of a unified agricultural development programme
AFTERNOON AND EVENING: FREE

Sunday, August 27

MORNING AND AFTERNOON: TOUR

Monday, August 28

MORNING: PAPERS AND DISCUSSIONS
Regional agreements for agricultural markets
Using surpluses for economic development
AFTERNOON: WORK GROUPS
EVENING: BUSINESS MEETING

Tuesday, August 29

MORNING AND AFTERNOON: PAPERS AND DISCUSSIONS
Environmental conditions for development
(a) *Educational*
(b) *Sociological*
(c) *Institutional*
(d) *Health and nutrition*
EVENING: ENTERTAINMENT

Wednesday, August 30

MORNING: (1) PAPER AND DISCUSSION
Using research findings in policy issues
(2) WORK GROUPS—SUMMING UP

Discussion topics planned for the Work Groups include: Agricultural policy (Spanish and English), Price policy, Farm management (Spanish and English), Land tenure problems (Spanish and English), Agricultural credit, Co-operation, Community development, Food and nutrition, Marketing (Spanish), Market practices, Market development, Extension, Teaching, Research methods, and Agricultural statistics.

For a list of the tours planned during and following the Conference, see announcement in the issue of last November, page 967.

Accommodations will be provided at the Casino de la Selva Hotel (700 people) and nearby hotels and motels. A limited number of single rooms is available, also doubles, triples, and cabins (accommodating two adults and two or three children). Prices (room and board, eleven days) are $74.80 to $96 (children under 10, $62.80).

Reservations should be made with the Mexican Committee, Antonio Tapia, Chairman, Venustiano Carranza 52, 4o. piso, Mexico 1, D.F., Mexico. To expedite communication of information regarding the conference, it is suggested that copies of reservations requests be sent also to the Secretary-Treasurer, Joseph Ackerman, at the Farm Foundation, 600 South Michigan Avenue, Chicago 5, Illinois.

AMERICAN ECONOMIC REVIEW

Volume LI *March 1961* *Number 1*

The AMERICAN ECONOMIC REVIEW, a quarterly, is the official publication of the American Economic Association and is sent to all members. The Annual dues are six dollars. Address editorial communications to Dr. Bernard F. Haley, Editor, AMERICAN ECONOMIC REVIEW, Stanford University, Stanford, California. For information concerning other publications and activities of the Association, communicate with the Secretary-Treasurer, Dr. James Washington Bell, American Economic Association, Northwestern University, Evanston, Illinois. Send for information booklet.

AGRICULTURAL HISTORY

Published by the Agricultural History Society

Editor: Fred W. Kohlmeyer
3 Commerce Annex, University of Illinois
Urbana, Illinois

Volume 35 *January, 1961* *Number 1*

This journal is published in January, April, July, and October. Yearly subscription $5.00. Interested individuals are invited to become members of the Society.

Secretary-Treasurer: Wayne D. Rasmussen
U. S. Agricultural Marketing Service, Washington 25, D.C.